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# MILITARY HANDBOOK

## INSPECTION AND CERTIFICATION OF BOILERS AND UNFIRED PRESSURE VESSELS

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## ABSTRACT

This handbook provides policy and guidance for inspection and testing of boilers and unfired pressure vessels at Navy shore installations. It is provided to ensure the safety of personnel and property. Direction is given to those persons responsible for the equipment and its inspection.

This handbook has 11 sections. The first 3 sections establish the scope of the inspection program by delineating the responsibilities for inspecting equipment, listing equipment exempted from the program, defining the qualifications required for inspectors, and providing inspection frequencies. Sections 4, 5, 6, and 7 provide guidance in regard to the procedures and tests used during inspections. Section 8 contains guidelines for repairing the equipment, whether by the government or private contractor. Section 9 establishes criteria for issuing inspection certificates. Sections 10 and 11 provide information for calculating a pressure vessel’s maximum allowable working pressure and for accident reporting, respectively.

# FOREWORD

This handbook provides guidance and criteria for the inspection of Navy shore establishment boilers and unfired pressure vessels. For maximum benefit, this handbook should be used in conjunction with the American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code (BPVC) and National Board of Boiler and Pressure Vessel Inspection, NB-23, National Board Inspection Code. In general, the handbook establishes standards for the inspection of boilers and pressure vessels. Specific guidance is provided in areas where there are no industry standards or where industry standards are unclear. In case of conflict, this handbook should be followed. The handbook is directed toward those persons who operate, maintain, and inspect boilers and unfired pressure vessels, whether directly or in a supervisory capacity.

Recommendations for improvement are encouraged from within the Navy, other government agencies, and the private sector and should be furnished on the DD Form 1426 provided inside the back cover to Commander, Naval Facilities Engineering Command, Code 161B, 1510 Gilbert Street, Norfolk, VA 23511-2699, phone (757) 322-4625.

THIS HANDBOOK SHALL NOT BE USED AS A REFERENCE DOCUMENT FOR PROCUREMENT OF FACILITIES CONSTRUCTION. IT IS TO BE USED IN THE PURCHASE OF FACILTIES ENGINEERING STUDIES AND DESIGN (FINAL PLANS, SPECIFICATIONS, AND COST ESTIMATES). DO NOT REFERENCE IT IN MILITARY OR FEDERAL SPECIFICATIONS OR OTHER PROCUREMENT DOCUMENTS.

# INSPECTION AND CERTIFICATION OF BOILERS AND UNFIRED PRESSURE VESSELS

CONTENTS

## APPENDIXES



## TABLES

# Section 1: INTRODUCTION

1.1 Purpose. This handbook covers the procedures necessary to determine the material condition of boilers and unfired pressure vessels to ensure their continued safe, reliable, and efficient operation. The procedures also require determination of combustion efficiency and proper operation of boilers, boiler auxiliaries, and controls. Exceptions to these requirements will not be made without the formal concurrence of the Naval Facilities Engineering Command's (NAVFACENGCOM) Boiler Inspection Certification Board. The authority for these requirements is a Chief of Naval Operations letter, dated 22 October 1970, Inspections of Boilers, Unfired Pressure Vessels, Elevators, Dumbwaiters, and Escalators. The frequency of inspection and testing, the various items or components to be inspected or tested, and the forms to be used are specified in this handbook.

1.2 Responsibility. The commanding officers of the cognizant activities ensure that the boilers and unfired pressure vessels installed at their facilities and covered by this handbook are certified as specified. Inspection and testing of boilers and unfired pressure vessels shall be made by a boiler inspector certified by NAVFACENGCOM Engineering Field Division (EFD) or Engineering Field Activity (EFA). This inspector will be on the cognizant activity's rolls, except where:

a) Inspection responsibility has been assigned to the commanding officer of a public works center.

b) Commanding officers of major or lead activities are responsible for performing the maintenance of public works and public utilities at adjacent activities.

c) It may be impractical to employ qualified personnel for such inspections because of the limited workload. In such situations, assistance in obtaining inspection services shall be requested from the appropriate EFD Commander or Commanding Officer, or EFA Commanding Officer. The EFD Commander or Commanding Officer, or EFA Commanding Officer shall arrange for the performance of those inspection services by an EFD or EFA inspector or an activity inspector or qualified personnel located near the requesting activity, or by contract. When assistance is required by the EFD or EFA, such assistance will be rendered on a reimbursable basis. The requesting activity is responsible for providing the funds to accomplish the inspections.

1.3 Applicability. This handbook is applicable to all heating and power boilers and unfired pressure vessels owned or leased by the naval shore establishment, including portable boilers and portable unfired pressure vessels, liquid propane gas LPG) storage tanks, and mobile utilities support equipment (MUSE) boilers. Gas storage flasks, volume tanks, fire water tanks, and filters with a cross-sectional internal dimension in excess of 3 inches are covered by this handbook. The following equipment is not covered by this handbook:

a) Cylinders including Department of Transportation (DOT) flasks, for shipment of compressed or liquefied gases. Defense Logistics Agency (DLA) Regulation No. 4145.25, Storage and Handling of Compressed Gases and Liquids in Cylinders, and of Cylinders of 16 Jan 90 governs.

b) Air tanks for air brakes on vehicles.

c) Unfired pressure vessels operating at an internal or external pressure not exceeding 15 pounds per square inch gage (psig) with no limitation on size.

d) Unfired pressure vessels containing only water under pressure at ambient temperature for domestic or industrial process supply purposes. Those containing air, the compression of which serves only as a cushion, must be inspected if pressures exceed those specified above.

e) Unfired pressure vessels used as refrigerant receivers for refrigerating and air conditioning equipment.

f) Coil type steam vapor cleaners unless requested by the activity.

g) Unit heaters (gas, electric, or steam).

h) Boilers and direct fired and domestic water heaters under 400,000 Btu/hour input capacity unless requested by the activity.

i) Residential and commercial warm air furnaces.

j) Fire extinguishers.

k) Shore-based hyperbaric facility pressure vessels used for manned operations or for testing animals or equipment.

1.4 Leased Boilers. Leased boilers shall be inspected by a contractor-provided boiler inspector meeting the requirements of paragraph 2.2. The EFD or EFA commanding officer reserves the right to have these boilers inspected by a NAVFACENGCOM (EFD or EFA) inspector.

1.5 Applicable Codes. The latest versions of the following codes are applicable in the inspection and testing of boilers and pressure vessels:

a) ASME, BPVC. Published by the American Society of Mechanical Engineers, New York, NY.

b) National Board of Boiler and Pressure Vessel Inspection, NB-23. Published by the National Board of Boiler and Pressure Vessel Inspection, Columbus, OH.

c) National Fire Protection Association (NFPA), National Fire Codes. Published by the National Fire Protection Association, Quincy, MA.

d) American National Standards Institute (ANSI)/ASME CSD-1, Controls and Safety Devices for Automatically Fired Boilers. Published by the American Society of Mechanical Engineers, New York, NY.

e) NAVFAC MO-225, Industrial Water Treatment Manual.

This handbook governs when a conflict occurs between the handbook and the codes.

1.6 Cancellation. This handbook, MIL-HDBK-1152, dated 30 September 1996, cancels and supersedes MO-324, dated April 1992.

# Section 2: INSPECTOR QUALIFICATIONS, CERTIFICATIONS, AND LICENSES

2.1 Navy Employees. Navy employees who perform the inspections, witness the tests, prepare the reports, and issue the certifications described in this handbook shall satisfy the following two conditions:

a) Possess a valid NAVFACENGCOM Certificate of Competency.

b) Possess a current license issued by the geographic EFD or EFA.

2.1.1 Qualifications for Certification. Candidates for the Certificate of Competency shall be qualified as follows:

a) The candidate inspector shall have education and experience:

(1) From an accredited school, a degree in mechanical engineering plus 1 year of experience in design, construction, operation, or inspection of high pressure boilers and pressure vessels. Accredited school is defined as an engineering school accredited by the Accreditation Board for Engineering Technology (ABET); or

(2) From an accredited school, a degree in a branch of engineering other than mechanical engineering plus 2 years of experience in design, construction, operation, or inspection of high pressure boilers and pressure vessels; or

(3) A high school education or the equivalent plus 3 years of experience in one of the following categories:

(a) In high pressure boiler and pressure vessel construction or repair.

(b) In charge of high pressure boiler and pressure vessel operation.

(c) In the inspection of high pressure boilers and pressure vessels.

b) Job Requirement. The inspection and certification of at least 10 boilers and/or unfired pressure vessels per year is part of the duties of the present or future position.

2.1.2 Certification Procedures. The activity shall recommend qualified candidates for certification to the NAVFACENGCOM Boiler Inspection Certification Board via the EFD or EFA. The letter of recommendation shall include:

a) Current position.

b) Occupational record

c) Educational background.

d) Supervisor's recommendation.

e) Proposed inspection workload. Minimum workload is the inspection of 10 boilers and/or unfired pressure vessels per year as specified by paragraph 2.1.1b.

f) Evidence of successful completion of the National Board of Boiler Inspectors (NBBI) qualification examination.

2.1.3 Inspector Certification Test. The qualification examination tests the ability of the candidate to understand the ASME BPVC. Candidates may wish to attend one of the commercially available boiler inspector preparatory schools. When requested by the EFD or EFA, the board will arrange the formal testing of qualified EFD or and activity candidates by members of the NBBI. To ensure scheduling the candidate for the NBBI examination, the information requested must be received at the NBBI prior to the date of the examination.

2.1.3.1 Employment. Only full time employees of the Navy will be certified. Gaps in employment do not affect certification, however, neither personnel not currently employed by the Navy nor part time employees will be permitted to perform inspections.

2.1.4 Qualifications for EFD or EFA Licensing. EFDs or EFAs shall license Navy employed inspectors every 2 years, providing they satisfy the following five conditions:

a) Possess a valid NAVFACENGCOM Certificate of Competency

b) Are full-time employees of the Navy.

c) Maintain an inspection workload of at least 10 boilers and/or unfired pressure vessels per year.

d) Conduct inspections in accordance with this handbook.

e) Are not employed in a capacity that constitutes a conflict of interest, as defined in paragraph 2.1.5.

2.1.5 Conflict of Interest. The EFD or EFA shall not license inspectors who:

a) Operate or maintain any of the boilers to be inspected.

b) Supervise the operation or maintenance of such boilers.

c) Report directly to the boiler operations supervisor in any capacity of their employment.

2.1.6 Inspector Support. Before licensing inspectors the EFD or EFA shall seek the following assurances from the employing activity:

a) Current applicable codes, equipment and tools are maintained and available to the inspector.

b) Records of inspection are maintained and available for examination by the EFD’s or EFA’s senior inspector or boiler inspection program manager.

c) The inspector will be available to other activities for inspection on a reimbursable basis, depending on workload.

2.2 Contract Employees. All persons employed by contractors that perform the inspections, witness the tests, prepare the reports, and issue the certificates described in this handbook shall, as a minimum, possess a Certificate of Competency or the equivalent issued by any political subdivision (such as state, province, territory, county, or city) of the United States or Canada that is a member of the NBBI except for contractors

performing inspections outside the United States. The Pacific Division and Atlantic Division of the NAVFACENGCOM shall set the requirements for contractors performing inspections outside the United States.

2.3 Credential Requirements. NAVFACENGCOM Form 9-11014/32, Inspection Certificates, for boilers and unfired pressure vessels may only be issued by inspectors who meet one of the two category requirements in Table 1.

Table 1
Credentials Required

| Category | Credentials Required | | |
|---|---|---|---|
| | State Certificate of Competency | NAVFACENGCOM Certificate of Competency | EFD or EFA License/ Authorization to Inspect |
| 1. Contract Inspector | X | | X |
| 2. Civil Service Inspector | | X | X |

Notes:

(1) A NAVFACENGCOM Certificate of Competency issued after September 1983 requires passing the NBBI examination. A NAVFACENGCOM Certificate of Competency issued before September 1983 required passing a Navy examination. In addition, authorization to issue NAVFACENGCOM Inspection Certificates requires EFD or EFA license.

(2) A contract inspector may not be employed by a contractor utilized to operate or maintain the equipment to be certified.

(3) In addition to the State Certificate of Competency, contract inspectors must have a written Authorization to Inspect from the geographical NAVFACENGCOM EFD or EFA. An official letter from a

member jurisdiction of the NBBI stating that the individual has passed the NBBI examination can be considered equivalent to the State Certificate of Competency.

2.4 Quality Assurance for Inspections. Appendix A shows the NAVFAC Boiler and Unfired Pressure Vessel Inspection Program Quality Assurance Organization. This organization provides a method of monitoring the performance of EFD or EFA, activity, and contract inspections. The key element of the organization is the senior EFD or EFA inspector. The duties and qualifications of the senior EFD or EFA inspector are outlined in Appendix B.

2.5 Guidelines for Inspection Contracts. The inspection of boilers and pressure vessels is highly specialized work requiring qualified personnel and, in many cases, specialized testing equipment. The contracting officer is responsible for ensuring the quality of inspections performed by companies awarded Navy inspection contracts.

2.5.1 Contractor Abilities. The ability of contractors and their inspectors to provide adequate inspections can be highly variable. The NBBI commissions inspectors of jurisdictions which have adopted and administer one or more sections of the ASME BPVC as a legal requirement and has a representative serving as a member of the ASME Conference Committee; or to an insurance company which is licensed by a state of the United States to write boiler and pressure vessel insurance. An authorized inspection agency is not working within the NBBI charter when performing inspections on a Federal reservation because a state's jurisdiction does not encompass military reservations and the Government does not insure its equipment. Furthermore, authorized inspection agencies usually do not qualify as small businesses.

2.5.2 Companies Other than Authorized Inspection Agencies. Quality assurance for such companies may not be structured according to a standard recognized by the NBBI or may even be non-existent. Contracting officers should ensure adequate inspections by requiring qualifications of the contractor before awarding the contract. These assurances should as a minimum include requiring the contractor to supply inspectors with the credential requirements of paragraph 2.3.

2.5.3 Assistance. Geographic EFDs or EFAs reduce the risk associated with inspection contracts by administering the contracts for activities. When an activity elects to administer its own inspection contract, the EFD or EFA provides assistance to the contracting officer by reviewing the contract requirements and determining the suitability of a company to perform inspections. The EFDs or EFAs provide this service on a reimbursable basis. The EFDs or EFAs also provide quality control by monitoring the performance of contractors and their inspectors. Upon satisfactory review, the EFD or EFA can issue an Authorization to Inspect to the firms qualifying inspectors for the term of the contract. The Authorization to Inspect identifies the ability of the inspector to perform the work satisfactorily and authorizes the inspector to sign the Inspection Report-Boiler or the Unfired Pressure Vessel Report and issue the Inspection Certificate NAVFAC Form 9-11014/32.

2.5.4 Activity Administered Contracts. When the activity contracting officer elects to administer the contracts, the contracting officer should require the contractors to provide enough information to determine positively that the firm has qualified inspectors and has the capability to do the required work. The scope of work for the inspection contract should include the number, function, type (such as boiler or pressure vessel), construction (such as the ASME BPVC or military specification), capacity, and pressure rating of each vessel. In addition, the contract should require that the contractor have:

a) Inspectors with credentials complying with paragraphs 2.1.1.b, 2.2, and 2.3.

b) An inspection work history similar to that required for the proposed work.

## Section 3: INSPECTION AND TEST FREQUENCIES

3.1 Boilers. Inspection and test frequencies for boilers are shown in Table 2.

Table 2
Inspection and Test Frequencies - Boilers

| Item | Internal Inspection | External Insp. & Operational Test | Hydrostatic Test |
|---|---|---|---|
| Boilers - Wet or dry lay-up | At least annually. At resumption of active service. | At least annually. At resumption of active service. | Tightness test at resumption of active service. |
| Boilers - Heating and LTW | At least annually. After any repair or alteration of pressure parts. | At least annually. After any alteration or modification to boilers, control equipment or auxiliaries. | Strength test at least once every 6 years. Tightness test all other years. Strength test after repair or alteration of pressure parts, additional times at the discretion of the inspector. |
| LTW boilers with Inputs <5 MBtu/hr | At least once every 3 years. | | |
| Boilers - Power, High Pressure, HTW, MUSE | At least annually. After any repair or alteration of pressure parts. | At least annually. After any alteration or modification to boilers, control equipment or auxiliaries. | Strength test at least once every 3 years. Tightness test all other years. Strength test after repair or alteration of pressure parts, additional times at the discretion of the inspector. |
| Domestic Hot Water Heaters | If applicable. | At least annually. | Discretion of inspector. Note: Glass-lined vessels not to exceed maximum allowable working pressure (MAWP). |

Table 2 (Continued)
Inspection and Test Frequencies - Boilers

Notes:

(1) Additionally, MUSE boilers and other boilers shall be inspected externally and internally and certified each time they are relocated from one activity to another. MUSE steam coil type boilers are exempt from annual inspections while in dry or wet lay-up.

(2) All manhole and handhole gaskets must be replaced after application of the strength test unless they are of the non-compressible steel type.

3.2 Unfired Pressure Vessels. Inspection and test frequencies for unfired pressure vessels shall be as shown in Table 3, Table 4, or Table 5, as applicable.

Table 3
Inspection and Test Frequencies - Unfired Pressure Vessels (UPVs)

| Item | Internal Inspection | External Insp. & Operational Test | Hydrostatic Test |
|---|---|---|---|
| Pressure Vessels & Heat Exchangers (15 to 250 psig MAWP) | Every 2 years or more frequently as determined by procedures in the NBBI Code for vessels subject to corrosion. After any repair or alteration of pressure parts. Inspection must include test and calibration of safety valves and pressure and temperature gages. For propane tanks see Table 4. | Every 2 years or more frequently as determined by procedures in the NBBI Code for vessels subject to corrosion. After any repair or alteration of pressure parts. Inspection must include test and calibration of safety valves and pressure and temperature gages. | After repair or alteration of pressure parts, additional times at the discretion of the inspector. |
| Pressure Vessels & Heat Exchangers (greater than 250 psig MAWP) | Every 2 years or more frequently as determined by procedures in the NBBI Code for vessels subject to corrosion. After any repair or alteration of pressure parts. Inspection must include test and calibration of safety valves and pressure and temperature gages. For propane tanks see Table 4. | Every 2 years or more frequently as determined by procedures in the NBBI Code for vessels subject to corrosion. After any repair or alteration of pressure parts. Inspection must include test and calibration of safety valves and pressure and temperature gages. | Every 6 years of service. If inspection shows no sign of corrosion, the test may be deferred until the next inspection, but must be tested at least every 12 years. After any repair or alteration of pressure parts, additional times at the discretion of the inspector. |

Table 3 (Continued)
Inspection and Test Frequencies - Unfired Pressure Vessels (UPVs)

Notes:

(1) Test frequencies and inspections may be increased at the discretion of the inspector or owner if the UPV is subjected, by the nature of its service, to an accumulation of deposits or thermal or mechanical stresses that could affect the integrity of the vessel.

(2) A hydrostatic pressure test not to exceed 1.5 times the MAWP for ASME Section VIII Division 1 vessels and 1.25 times the MAWP for ASME Section VIII Division 2 vessels may be substituted for the internal inspection.

(3) If the tube bundle of the heat exchangers is a higher pressure than the shell, both sides of the heat exchanger shall be hydrostatically tested.

(4) Unfired pressure vessels shall be inspected externally and internally and recertified anytime they are relocated or moved.

Table 4
Inspection and Test Frequencies - UPVs (Special Cases)

| Item | Internal Inspection | External Insp. & Operational Test | Hydrostatic Test |
|---|---|---|---|
| MILSPEC Vessels | Every 2 years of service. Inspection must include test and calibration of safety valves and pressure and temperature gages.<br><br>See Note 1. | Every 2 years of service. Inspection must include test and calibration of safety valves and pressure and temperature gages. | Every 6 years of service. If inspection shows no sign of corrosion, the test may be deferred until the next inspection, but must be tested at least every 12 years, additional times at the discretion of the inspector. In accordance with paragraph 5.4.3. |
| | Activities may elect to prepare and inspect MILSPEC vessels using NAVSEASYSCOM boiler inspectors according to Naval Ship's Technical Manual S9086-SY-STM-010, Chapter 551, "Compressed Air Plants." To reduce duplication of effort, no NAVFACENGCOM certificate is necessary as long as the vessel has a valid NAVSEASYSCOM safety certificate. A pressure vessel which is neither MILSPEC nor ASME Code may only be certified when design drawings and engineering calculations from the manufacturer are available to the inspector to positively determine whether the vessel is safe to operate. The inspector may ask for proof of the manufacturer's quality control procedures and tests prior to issuing a certificate of safety. | | |
| Liquid Propane Gas (LPG) Storage Tanks | Every 2 years or more frequently as determined by procedures in the NBBI Code. After any repair or alteration of pressure parts. Ultrasonic testing may be substituted for visual internal inspection. Bench test or replace the UL or ASME safety valves every 6 years. See Note 2. | Every 2 years or more frequently as determined by procedures in the NBBI Code. After any repair or alteration of pressure parts. Bench test or replace the UL or ASME safety valves every 6 years. | After any repair or alteration of pressure parts, otherwise at the discretion of the inspector. |

Table 4 (Continued)
Inspection and Test Frequencies - UPVs (Special Cases)

Notes:

(1) A visual internal inspection for MILSPEC vessels is not required every 2 years provided the vessel (or vessel bank) successfully passes a gas analysis oil mist plus particulate matter concentration equal to or less than 5 milligrams per cubic meter and dew point equal to or colder than 40 degrees F; and an ultrasonic thickness measurement check in accordance with paragraph 5.4.2. The maximum acceptable interval between visual inspections is 12 years.

(2) The minimum required rate of safety valve discharge for aboveground tanks shall be in accordance with the following table:

| Tank Surface Area Square Feet | Flow Rate CFM Air | Tank Surface Area Square Feet | Flow Rate CFM Air |
|---|---|---|---|
| 20 or less | 626 | 250 | 4,960 |
| 25 | 751 | 300 | 5,760 |
| 30 | 872 | 350 | 6,540 |
| 35 | 990 | 400 | 7,300 |
| 40 | 1,100 | 450 | 8,040 |
| 45 | 1,220 | 500 | 8,760 |
| 50 | 1,330 | 550 | 9,470 |
| 55 | 1,430 | 600 | 10,170 |
| 60 | 1,540 | 650 | 10,860 |
| 65 | 1,640 | 700 | 11,550 |
| 70 | 1,750 | 750 | 12,220 |
| 75 | 1,850 | 800 | 12,880 |
| 80 | 1,950 | 850 | 13,540 |
| 85 | 2,050 | 900 | 14,190 |
| 90 | 2,150 | 950 | 14,830 |
| 95 | 2,240 | 1,000 | 15,470 |
| 100 | 2,340 | 1,050 | 16,100 |
| 105 | 2,440 | 1,100 | 16,720 |
| 110 | 2,530 | 1,150 | 17,350 |
| 115 | 2,630 | 1,200 | 17,960 |
| 120 | 2,720 | 1,250 | 18,570 |
| 125 | 2,810 | 1,300 | 19,180 |
| 130 | 2,900 | 1,350 | 19,780 |
| 135 | 2,990 | 1,400 | 20,380 |
| 140 | 3,080 | 1,450 | 20,980 |
| 145 | 3,170 | 1,500 | 21,570 |
| 150 | 3,260 | 1,550 | 22,160 |
| 155 | 3,350 | 1,600 | 22,740 |
| 160 | 3,440 | 1,650 | 23,320 |
| 165 | 3,530 | 1,700 | 23,900 |
| 170 | 3,620 | 1,750 | 24,470 |
| 175 | 3,700 | 1,800 | 25,050 |
| 180 | 3,790 | 1,850 | 25,620 |
| 185 | 3,880 | 1,900 | 26,180 |
| 190 | 3,960 | 1,950 | 26,750 |
| 195 | 4,050 | 2,000 | 27,310 |
| 200 | 4,130 | | |

Table 5
Inspection and Test Frequencies - Deaerators

| Item | Internal Inspection | External Insp. & Operational Test | Hydrostatic Test |
|---|---|---|---|
| Deaerators | Every 10 years. After any repair or alteration of pressure parts. Inspection must include test and calibration of safety valves and pressure and temperature gages. | Every 10 years. After any repair or alteration of pressure parts. Inspection must include test and calibration of safety valves and pressure and temperature gages. | Tightness test after internal inspection. Strength test after repair or alteration of pressure parts, additional times at the discretion of the inspector. |

Notes:

(1) If inspection reveals that repairs must be made to pressure parts, then the inspection frequency will be increased to every 6 years. No certificate of inspection will be issued until after the repairs are accomplished. Inspection may again be increased to a 10-year cycle, if at least two subsequent inspections reveal no further evidence of cracking or excessive corrosion.

(2) In addition to the safety inspection, the operators of the vessel should periodically examine and test the deaerators for proper operation. Improperly operating deaerators result in excessive corrosion and cracking. The key to satisfactory operation is proper water treatment.

(3) Scheduling of deaerator inspection at many facilities requires scheduled downtime for many heating and power plants. The activity should prepare to hire a company specializing in

deaerator evaluations to determine if the vessel is repairable if cracking or excessive corrosion is found during the visual inspection. Options to lease deaerators prior to the inspection should be considered. Assistance may be obtained from the geographic EFD or EFA.

## Section 4: BOILER INSPECTIONS

4.1 Guidance. The activity operating and maintaining the boiler shall provide all material and labor necessary to prepare the boilers for inspection in accordance with the NBBI Code. The activity shall assist the inspector as required during the inspections. Exception to this policy occurs when the operation and maintenance of a boiler is under the cognizance of a contractor. In this case, the contractor shall be responsible for providing material, labor, and assistance. Inspections of boilers located on Navy bases in foreign countries must comply with MIL-HDBK-1152 under the constraints of the Status Force Agreement in effect. Inspectors should not compromise safety issues, but should exercise restraint when interpreting the fine points of the ASME Code. Further guidance on foreign inspections should be obtained from the cognizant geographic EFD or EFA serving the activity.

4.2 External Inspection of Boilers. External inspections of boilers shall be made in accordance with Part RB-3100, "External Inspections of Boilers," of the National Board Inspection Code. The testing of safety devices shall occur as part of the external inspection. Final testing of the safety valves of power boilers shall be on the boiler to which the valve will be mounted. The operational tests and observations of Section 7 are considered to be part of the external inspection.

4.3 Internal Inspections of Boilers. Internal inspections of boilers shall be made in accordance with Part RB-2020, "Internal Inspections of Boilers-Power and Heating," of the National Board Inspection Code. Boiler inspectors shall have the authority to order that boiler metal samples and/or ultrasonic tests be taken for their examination to ascertain the actual condition of the pressure parts.

4.4 Boilers in Wet or Dry Lay-Up. In addition to the external and internal inspections required above, the lay-up procedures being used shall be reviewed to ensure that they conform to the requirements of Appendix C.

## Section 5: UNFIRED PRESSURE VESSEL INSPECTIONS

5.1 Guidance. The activity operating and maintaining the pressure vessel shall provide all material and labor necessary to prepare the unfired pressure vessel for inspection in accordance with the NBBI Code. The activity shall assist the inspector as required during the inspections. Exception to this policy occurs when the operation and maintenance of the pressure vessel is under the cognizance of a contractor. In which case, the contractor shall be responsible for providing material, labor, and assistance. Inspections of pressure vessels located on Navy bases in foreign countries must comply with MIL-HDBK-1152 under the constraints of the Status Force Agreement in effect. Inspectors should not compromise safety issues, but should exercise restraint when interpreting the fine points of the ASME Code. Further guidance on foreign inspections should be obtained from the cognizant geographic EFD or EFA serving the activity.

5.2 External Inspections of Pressure Vessels. External inspections of unfired pressure vessels shall be made in accordance with Part RB-3200, “Inspections of Pressure Vessels,” of the National Board Inspection Code.

5.3 Internal Inspections of Pressure Vessels. Internal inspections of unfired pressure vessels shall be made in accordance with Part RB-2030, “Internal Inspections of Pressure Vessels,” of the NBBI Code. Inspectors shall have the authority to order metal samples and/or ultrasonic tests for their examination to ascertain the actual condition of the vessel.

5.4 Military Specification (MILSPEC) Vessels

5.4.1 Internal and External Inspections. Vessels shall be examined in accordance with paragraphs 5.2 and 5.3. Internal surfaces shall be viewed using a boroscope, if necessary, supplied by the activity or by another acceptable method. Areas of wear, corrosion, abuse, and/or damage shall be recorded and attached to the inspection report.

5.4.2 Ultrasonic Examination. Vessels shall be subjected to an ultrasonic thickness measurement check. The checks shall be made by the activity and observed by the inspector. The checks shall be made at the point of tangency between the cylinder and the end heads. The measurements shall be taken at

2-inch intervals around the circumference of the vessel. Measurements shall be taken on a line along the head from the point of tangency, across the end of the head to the far point of tangency; measurements shall be taken along a similar line at right angles to the first at the end of the head. Lines of measurement shall be taken at each end of the vessel. The lines shall be so arranged that the vessel low point, where water may collect and corrosion may form, is measured. Measurements shall be taken every 2 years. Ultrasonic measurement points for vessel configurations other than spherical or cylindrical shall be approved by the inspector. The lines and points of measurement shall be identical at each inspection. Records of the measurements shall be retained by the activity. The vessel shall not be derated nor certified if the measured thickness is less than that prescribed by the standard by which is was constructed, for example, Military Specification MIL-F-22606B, Flask Compressed Gas and End Plugs for Air, Oxygen, and Nitrogen (SHIPS).

5.4.3 Examination of High Stress Areas. A liquid dye penetrant or magnetic particle examination or other method authorized by the NAVFACENGCOM Boiler Inspection Certification Board shall be performed on all areas of high stress concentration such as nozzles, welds, plugs, threads, etc., before each strength test. The purpose of this examination is to identify any defects which have occurred as a result of high or cyclic stresses.

5.4.4 Variations. Requests for variations in the inspection and testing procedures for MILSPEC pressure vessels should be addressed to the NAVFACENGCOM Boiler Inspection Certification Board with a copy to the cognizant geographic EFD or EFA. Appendix A depicts the relative position of the Boiler Inspection Certification Board in the NAVFACENGCOM boiler and pressure vessel inspection quality assurance organization.

5.5 Deaerators. The purpose of a deaerating heater (deaerator) is to remove non-condensable gases and dissolved oxygen from the feedwater. A properly operating deaerator will have no more than 10 ppb (parts per billion) O2 in the outlet water. Deaerators are subject to thermal cycling and corrosion. Proper operation of deaerators is extremely important because of their critical function in protecting the boiler system from corrosion. Catastrophic failure of deaerators is usually attributable to cracks forming longitudinally and transversely to

the heat affected zones of the welds. Deaerators are potentially a great danger because of their location at the top of the heating or power plant. To ensure deaerators provide safe reliable service, they require periodic visual inspections of their internal and external surfaces. If visual inspection reveals cracking, then a company specializing in deaerator inspection must perform an ultrasonic examination of the entire vessel and wet fluorescent magnetic particle examinations of the heat affected zones of the welds prior to certification to determine if continued operation of the vessel is safe. Repairs must be subjected to post-weld heat treatment and hydrostatic testing prior to certification.

## 5.6 Liquid Propane Gas (LPG) Tanks

5.6.1 External Inspection. Propane tanks shall be examined in accordance with paragraph 5.2. Areas of wear, corrosion, abuse, and/or damage shall be recorded and attached to the inspection report. Check capacity rating on safety relief valve nameplate for proper valve discharge.

5.6.2 Internal Inspection. Propane tanks contain a non-corrosive liquid, and have virtually no internal corrosion. Vessels shall be inspected by means of an ultrasonic thickness measurement check.

5.6.3 Hydrostatic Test. Hydrostatic tests shall be performed after any repair or alteration of pressure parts (additional times are at the discretion of the inspector). Prior to performing a hydrostatic test, verify if support structure is adequate to support the weight of the hydrostatic liquid. If a hydrostatic test is not possible, request approval for a pneumatic test from the NAVFAC Boiler Inspection Certification Board.

5.6.4 Safety Relief Valves. Propane tanks shall be fitted with ASME Division VIII Section 1 certified, or Underwriters Laboratories UL 132 stamped, spring loaded safety relief valves. Safety relief valves for LPG service shall not be fitted with lifting devices. Safety relief valves shall be removed and replaced or bench tested every 6 years of service by a company authorized to perform such tests on either ASME or UL safety valves.

# Section 6: PRESSURE TESTS

6.1 Hydrostatic Tests. Hydrostatic tests shall be made in accordance with the paragraphs below and the National Board Inspection Code, Part RB-3140 “Evidence of Leakage” for boilers, and Part RB-3234 “Pressure Testing” for unfired pressure vessels.

6.1.1 Strength Test Pressure. Strength tests shall be based on the maximum allowable working pressure of the boiler or pressure vessel as marked or as recalculated as a result of previous tests. All boilers and unfired pressure vessels covered by ASME Section I or Section VIII, Division 1 subjected to internal pressure shall be tested hydrostatically at a pressure of 1-1/2 times the highest safety valve popping pressure or 1-1/2 times the MAWP, whichever is less. Unfired pressure vessels constructed by the standards of ASME Section VIII, Division 2 subjected to internal pressure shall be tested hydrostatically at a pressure of 1-1/4 times the highest safety valve popping pressure or 1-1/4 times the MAWP, whichever is less. Exceptions follow:

a) Vessels that are not capable of supporting the weight of liquids (see Section 10, MAWP and paragraph 6.2, Pneumatic Tests) cannot be tolerated.

b) Vessels not readily dried that are to be used in services where traces of the testing liquid cannot be tolerated (see paragraph 6.2, Pneumatic Tests).

c) The test pressure for enameled vessels shall be at least equal to, but need not exceed, the maximum allowable working pressure marked on the vessel.

d) The test pressure for glass-lined vessels shall not exceed the maximum allowable working pressure.

e) The test pressure for cast iron vessels shall be 2 times the maximum allowable working pressure for maximum allowable working pressures greater than 30 psig and 2-1/2 times the maximum allowable working pressure but not to exceed 60 psig for maximum allowable working pressures under 30 psig.

f) The test pressure for vessels and piping in high pressure air systems (3,000 psig and over) shall be 1-1/2 times the maximum allowable working pressure of the system.

g) The test pressure for new boilers and new unfired pressure vessels shall be 1-1/2 times the maximum allowable working pressure. The test pressure for subsequent tests shall not exceed 1-1/2 times the maximum allowable working pressure.

6.1.1.1 Vacuum Vessels. Single-wall vessels designed for a vacuum or partial vacuum only, and chambers of multi-chamber vessels designed for vacuum or partial vacuum only, need not be subjected to a hydrostatic test.

6.1.1.2 Special Combination Units. Special combination units shall be so tested that each pressure chamber (vessel) receives the required hydrostatic test without pressure in the others.

6.1.1.3 Hydrostatic Tests with Fluids Other than Water. The test procedures for fluids other than water must be approved by the NAVFACENGCOM Boiler Inspection Certification Board.

6.1.2 Tightness Test Pressure. The tightness test pressure shall be above the normal operating pressure, but shall not exceed the lowest safety valve set pressure. Safety valves shall be blocked or gagged for this test.

6.1.3 Precautions

a) Direct connection of the boiler to the water system is prohibited where a back-flow preventer is not installed to prevent contamination of the potable water system.

b) A power-driven or hand pump shall be provided for application of the test pressure if the boiler feed pump will not deliver the test pressure. The test pump shall be provided by the activity and operated and inspected to ensure that it is in proper working condition prior to connecting it to the boiler or the vessel.

6.1.4 Possible Deformation. If any indications of probable permanent deformation are observed, the test shall cease until the weak parts have been properly strengthened. If necessary repairs are not practicable, a new test, progressing up to 20 psi less than the pressure at which the proceeding test ceased, shall be applied. If the test is successful, the new maximum allowable working pressure shall be two-thirds of the test pressure, and the safety valves shall be reset or replaced in accordance with the new maximum allowable working pressure.

6.1.5 Hold Pressure. For all boilers and heat exchangers, pressure shall not drop more than 10 percent within 15 minutes. If pressure drop exceeds 10 percent, leaks shall be repaired and the test repeated. If pressure drop is within 10 percent and inspection does not reveal leaks in the pressure parts, it may be assumed that the leaks are through the isolation valves, manholes, and handholes.

6.1.6 Inspection Under Pressure. All joints and connections shall be inspected for leaks or other defects while the vessel is under pressure. The pressure held during this inspection need not necessarily be equal to the hydrostatic test pressure, but shall be not less than two-thirds of the hydrostatic pressure.

6.1.7 Permanent Deformation. Where permanent deformation of the unfired pressure vessel shell or heads, or of the boiler shell or drum has occurred, whether as a result of hydrostatic pressure tests or from normal operating pressures, repairs shall be made only after it has first been definitely determined that such repairs are practicable and economical. After approved repairs of this nature have been completed, the maximum allowable working pressure of the vessel or boiler shall be re-calculated according to the requirements of Section 10. Prior to returning the vessel or boiler to service, a hydrostatic test, based on the recalculated maximum allowable working pressure, shall be made.

6.1.8 Gaskets. Manhole and handhole gaskets shall be replaced after performing the hydrostatic strength test unless a non-compressible metal gasket is used.

6.2 Pneumatic Tests. A pneumatic test should be performed only in extreme cases when a hydrostatic test is not permissible. No pneumatic tests shall be performed without the written approval of the NAVFACENGCOM Boiler Inspection Certification Board. This approval can be granted by submitting a request in writing to NAVFACENGCOM via the geographic EFD or EFA. Pneumatic test procedures for each particular test are in UG-100 for Section VIII Division 1 vessels, and in Article T-4 for Section VIII Division 2 vessels. The pneumatic test pressure shall be 1.25 times the MAWP for Division 1 vessels and 1.15 times the MAWP for Division 2 vessels. A pneumatic test may be used in lieu of the hydrostatic test prescribed in paragraph 6.1 of this section, with NAVFACENGCOM approval as follows:

a) For vessels that are so designed and/or supported that they cannot safely be filled with water.

b) For vessels not readily dried that are to be used in services where traces of the testing liquid cannot be tolerated and the parts of which have, where possible, been previously tested by hydrostaic test pressure.

6.3 Pressure Test Results

6.3.1 Yielding During Test. If yielding occurs, and examination shows the vessel is in satisfactory condition, the maximum allowable working pressure shall be established as 50 percent of the pressure at yielding.

6.3.2 No Yielding During Test. If yielding does not occur, the pressure should be increased step by step until the required test pressure has been reached. Then the pressure shall be held for a sufficient time to permit inspection of the vessel for leakage or signs of failure.

6.3.3 Inspection Under Pressure. If permanent deformation occurs, the vessel shall be replaced or repaired. If permanent deformation occurs in a vessel not constructed to the ASME BPVC, the vessel shall be drilled and discarded.

# Section 7: OPERATIONAL TESTS

7.1 Guidance. Following internal inspection, as part of the external inspection, the boiler or unfired pressure vessel shall be brought up to operating pressure and temperature. All automatically and manually operated control devices provided for controlling the operation and safety of the vessel, steam or water pressure, hot water temperature, combustion, and boiler water level shall be inspected and caused to function under operating conditions. All associated valves and piping, pressure and temperature indicating devices, metering and recording devices, and all boiler auxiliaries shall be inspected under operating conditions. Boilers firing oil or gas without fully automatic or semiautomatic controls must have an EFD or EFA waiver to be certified. All combustion controls attached to the boiler, regardless of the fuel being fired, must be in good working order or the inspection certificate shall be withheld. Inspections and tests of boilers may be made with the main steam or hot water distribution valves closed or open, as necessary, to fire the boiler and operate it under normal operating conditions. Testing the function of automatically or manually controlled devices and apparatus that may interfere with the distribution requirements should be done with the main steam or hot water distribution valves closed, as applicable.

7.1.1 Purpose. The purpose of these additional inspections and tests is to allow the inspector to discover any inefficient or unsafe operation or maintenance of the vessel, the boiler, or its auxiliaries that may be evidenced under operating conditions.

7.1.2 Conditions to be Reported. All deficiencies requiring adjustment, repair, or replacement, and all conditions indicating excessive operating and maintenance cost shall be reported. Certificates shall be withheld until the deficiencies are corrected.

7.2 Firing Equipment. The operation of all firing equipment, including oil burners, gas burners, fuel injectors, fuel igniters, coal stokers, and feeders, burner safety controls and other such equipment provided to introduce fuel into the boiler furnace and to ignite the fuel, shall be inspected for any deficiency that may be evidenced under operating conditions. All fuel leaks must be repaired before the certificate is issued.

7.3 Controls. Inspect the operation of all controls directly associated with the operation and safety of the boiler for any defects preventing proper operation. These controls include such items as unloading valves, high pressure cut-out devices, high temperature cut-out devices, low pressure cut-in devices, and burner safety controls. Inspect the operation of combustion controls, steam pressure controls, water temperature controls, and feedwater controls. Make sure that the ability of the combustion control and steam pressure control to maintain proper steam pressure (or water temperature in high temperature water installations) and air-fuel ratio is demonstrated throughout the capacity range of the boiler and the load swings encountered in the operation of larger boilers. Air-fuel ratio shall be checked by the activity or the inspector by both CO2 and O2 measuring devices. CO shall also be checked. Check fully automatic boiler controls for the proper programming sequence and timing with respect to pre-purge, ignition, pilot proving, flame proving, and post-purge periods. Check the operation of flame failure and combustion air failure devices to ensure that they properly shut off the supply of fuel; this should be done by simulating a flame failure (by manually shutting off the fuel or by other means) and by observing the operation of the controls, solenoid valves, diaphragm operated valves and so forth, which are to operate during a flame failure. The operation of automatic burner management systems shall comply with the National Fire Codes or ANSI/ASME CSD-1 in effect at the time of installation of the boiler. Inspect feedwater controls, and check the ability of the controls to maintain proper water level throughout the range of capacity with load swings. Check the operation of the low-water fuel cutoff and automatic water feeding devices by draining the float bowl, lowering the boiler water level, and performing the necessary steps to cause these devices to function to ensure that they operate properly.

7.4 Piping and Piping Connections. While the boiler (or vessel) is operating, examine all steam and water pipes, including connections to the water columns and all associated piping, for leaks. If any leaks are found, determine whether they are the result of excessive strains due to expansion, contraction, water hammer, or other causes. Look for undue vibration, particularly in piping connections to the boiler and the vessel. Where excessive vibration is found, examine connections and parts for a tendency to crystallize.

7.5 Devices

7.5.1 Temperature Indicating Devices. All temperature indicating devices shall be observed for indications of excessive temperatures, particularly during and immediately following the time when high load demands are made on the boiler and the vessel.

7.5.2 Metering and Recording Devices. While the boiler is operating under normal conditions, observe the operation of all metering and recording devices. When there is evidence that any such device is not functioning properly, it shall be adjusted, repaired, or replaced as necessary.

7.6 Valves

7.6.1 Blow-Down Valves. Test the freedom of each blow-down valve and its connections by opening the valve and blowing down the boiler for a few seconds. Determine whether the valve is excessively worn or otherwise defective, and whether there is evidence of restrictions in the valve or connected piping preventing proper blow-down of the boiler.

7.6.2 Stop and Check Valves. While the boiler (or vessel) is operating, inspect the operating condition of each stop and check valve where possible. Serious defects of externally controlled stop valves may be detected by operating the valve when it is under pressure. Similarly, defects in check valves may be detected by listening to the operation of the valve or by observing any excessive vibration of the valve as it operates under pressure.

7.6.3 Pressure Reducing Valves: While there is pressure on the system, and as safety and operating conditions permit, open and close the by-pass valve. Then observe the fluctuation of the pressure gage pointer as an aid in determining possible defects in the operation of the pressure reducing valve or the pressure gage. Look for evidence that may indicate improper condition of the relief or safety valves provided for pressure reducing valves.

7.6.4 Safety and Safety Relief Valves. Inspect the valves for evidence of leaks and proper operation. Check the popping pressure and blow-down of safety valves by allowing the pressure of the boiler to rise so that the valves lift. The valve drains

and discharge shall be inspected to ensure that they are free from obstructions and installed according to the ASME Code. For multiple valve operations, where an accumulation test cannot be accomplished, the freedom of the valve to lift shall be checked using the lifting lever provided the pressure is within 10 percent of the valve set pressure. Similarly, safety relief valves should be checked by using the lifting lever. Proper installation and operation is necessary prior to issuing an inspection certificate.

7.7 Boiler Auxiliaries. While the boiler is operating under normal conditions, observe the operation of all boiler auxiliaries for any defects which may prevent the proper functioning of the boiler or which may indicate a lack of proper maintenance. The unnecessary use of multiple auxiliaries or the use of a large auxiliary during a light load period (when a smaller auxiliary could be substituted) should be discouraged. The maximum use of steam-driven auxiliaries short of atmospheric exhaust should be encouraged. Steam leaks, wastage to atmosphere, and so forth, should be called to the attention of the operating personnel. Particular attention should be given to deaerator venting practice. Venting should be held to the minimum required to preclude oxygen entrainment in the feedwater. When intermittently operating condensate pumps are used, look for any tendency toward the creation of a vacuum when a pump starts. If this happens, the installation of a small continuously operating, float throttled, condensate pump (in parallel with intermittently operating pumps) will ensure a condensate flow at all times. If there are a number of intermittently operating condensate pumps, it may be possible to convert one of them (if of small enough capacity) to continuous throttled operation.

7.8 Boiler and Feedwater Treatment. The operation of equipment provided for boiler and feedwater treatment shall be observed, and the materials and procedures used for boiler and feedwater treatment should be checked to ensure adequate protection against scale and corrosion in the boiler, plant, equipment, and distribution system. The internal condition of the boilers, as evidenced from inspections required under Section 4, Internal Inspection, shall be the determining factor regarding the adequacy of materials and procedures used in boiler and feedwater treatment. The certificate shall be withheld if an effective boiler water treatment program is not being implemented.

7.9 Fuel Handling Practices. The inspector shall check the fuel handling practices and make recommendations toward the elimination of multiple handling, heating of tanks not in use, and the simultaneous use of heaters in a duplex fuel oil pump and heater set where load conditions do not require this procedure. Heating of entire tanks should be avoided. Heating within a tank should be limited to heating at the suction point only. With respect to residual fuel oil tanks, frequent tank changes (extending to the tank bottom) should be encouraged as a means of precluding sludge buildup.

## Section 8: REPAIRS AND ALTERATIONS

8.1 Guidance. Repairs to the equipment may be necessary before certification. The activity may already be aware of necessary repairs prior to any inspections and tests. Prior to issuing a certificate, all deficiencies which cause an unsafe condition must be corrected. The repairs must be completed in accordance with the applicable code. For pressure parts, repairs must be performed in accordance with the ASME Code. For combustion control safeguards (burner safety controls), the equipment must be repaired to meet the requirements of the National Fire Codes or ANSI/ASME CSD-1, as applicable. When deficiencies are found in the pressure parts of MILSPEC pressure vessels or pressure vessels of undetermined code origin, the vessels must be rendered inoperable in such a way as to prevent further use. To ensure safe operating conditions, repairs to flame safeguard equipment shall only be made by the manufacturer or his authorized representative.

8.2 Contractor Repairs. NAVFAC Letter 11370/02, 1637, Inspection and Certification of Boilers and Unfired Pressure Vessels," of 18 May 1995, allows activities the option of using Navy welders qualified in accordance with the applicable Mil-Standards to make repairs and alterations to boilers and unfired pressure vessels, or a contractor holding a NBBI (R) stamp in accordance with Part RC of the National Board Inspection Code. For welding repairs or alterations, the contractor shall complete a National Board Form R-1 and stamping and nameplate attachment is required.

8.3 Setting Safety Valves. The setting of safety valves of power boilers within the limits of ASME Section I are adjustments. Other changes in settings, welding, or machining are repairs. Repairs and adjustments of safety valves are not valid unless performed by the manufacturer or a valve repair company. Repairs by the government are prohibited. The contractor shall be required to affix a National Board VR name-plate to the repaired valve. Whether the safety valve is repaired or adjusted; the breaking of the seal, the setting of

the valve, and resealing of the valve shall be documented. Power boilers are not certifiable unless all safety valves are sealed and tagged.

8.4 Records. If this information is acceptable to the inspector, the repairs or alterations shall proceed and be inspected. Upon inspector approval of the work, the activity shall make a permanent record of the repairs or alterations.

## Section 9: INSPECTION CERTIFICATES AND REPORTS

9.1 Procedures for Submitting Reports and Forms. The following hard copy reports and forms, or computer reports approved by the geographic EFD or EFA, will be used in the inspection and testing of boilers and unfired pressure vessels. An example of each is contained in Appendix D.

9.1.1 Inspection Reports - Boilers and Unfired Pressure Vessels. The applicable report is to be completed by the inspector to record the condition of the boiler or unfired pressure vessel, the tests performed, and the issuance of the certificate. One copy is to be retained in the activity files for a period of at least 2 years and one copy forwarded to the geographic EFD or EFA within 30 days of the inspection. The inspector shall promptly notify the Public Works Officer of the activity whenever inspection reports indicate safety deficiencies, pressure reductions, and unserviceability.

9.1.2 Inspection Certificate for Boilers - Unfired Pressure Vessels; NAVFAC Form 9-11014/32. A current and valid certificate, or commercial equivalent authorized by NAVFACENGCOM for contract inspection, shall be posted on, or near, the equipment under a clear protective covering. Operation of the equipment without the certificate is not authorized. The certificate shall be issued under the following conditions:

a) No Deficiencies: The inspector shall complete and sign after the test inspection.

b) Deficiencies Not Affecting Operating Safety: May be issued, but correction must be recorded on the Inspection Report - Boilers.

c) Deficiencies Affecting Operating Safety: Withheld until corrected and re-inspected. The activity Public Works Officer and the EFD or EFA shall be notified in writing listing the specific deficiencies.

d) Pressure Reduction: Issued for the reduced working pressure. Oral notification, confirmed in writing, shall be made by the inspector to the activity Public Works Officer and the EFD or EFA.

e) Unserviceable: No certificate may be issued. The inspector shall notify the activity Public Works Officer and the EFD or EFA in writing of the deficiencies.

f) Vessels of Unknown Origin: Certificate may be issued provided it is accompanied by a plan of action with milestones to replace the vessel prior to the next inspection cycle.

## Section 10: MAXIMUM ALLOWABLE WORKING PRESSURE

10.1 Guidance. The MAWP shall be determined as described in the National Board Inspection Code. The following paragraphs provide further guidance on MAWP. Defects or damage discovered during the inspection shall be repaired in accordance with Section 8. If, in the judgment of the inspector, a steam or hot water boiler or vessel is unsafe for operation at the pressure previously approved, the pressure shall be reduced, proper repair made, or the boiler or vessel shall be condemned.

10.2 Standard Boilers. (Including expansion drums on high temperature water installations.) The maximum allowable working pressure of a boiler built in accordance with the ASME Code shall in no case exceed the pressure indicated by the manufacturer's identification stamped or cast upon the boiler or upon a plate secured to it. Specific requirements governing the maximum allowable working pressure on the following standard boilers shall be followed.

10.2.1 Standard Watertube Boilers. The maximum allowable working pressure on a standard watertube boiler, the tubes of which are secured to cast iron or malleable iron headers, or which have cast iron mud drums, shall not exceed 160 psig.

10.2.2 Standard Cast Iron Steam Boilers. The maximum allowable working pressure for a standard cast iron steam boiler shall not exceed 15 psig. Standard cast iron hot water boilers operating at temperatures not to exceed 250 degrees F may be operated at pressures up to 160 psig.

10.3 Nonstandard Boilers

10.3.1 Nonstandard Riveted Boilers. The maximum allowable working pressure on the shell of a nonstandard riveted heating boiler shall be determined in accordance with the ASME Code, except that in no case shall the maximum allowable working pressure of a steam heating boiler exceed 15 psig, or a hot water boiler exceed 160 psig at a temperature not exceeding 250 degrees F.

10.3.2 Nonstandard Welded Boilers. The maximum allowable working pressure of a nonstandard steel or wrought iron heating boiler of welded construction shall not exceed 15 psig for steam. For other than steam service, the maximum allowable working pressure shall be calculated in accordance with the ASME Code.

10.3.3 Nonstandard Cast Iron Boilers. The maximum allowable working pressure of a nonstandard boiler composed principally of cast iron shall not exceed 15 psig for steam service, or 30 psig for hot water service. The maximum allowable working pressure of a nonstandard boiler having cast iron shell or heads and steel or wrought iron tubes shall not exceed 15 psig for steam service or 30 psig for hot water service.

10.4 Calculations of Maximum Allowable Working Pressure. When inspection indicates that the thickness of the plate or the strength of any joint is less than that on which the current maximum allowable working pressure is based, or when it is impracticable to apply the required hydrostatic test, a new maximum allowable working pressure shall be calculated in accordance with the rules of the ASME Code. The following factors of safety shall be used and increased by the inspector if the condition and safety of the boiler demand it:

a) The lowest factor of safety permissible on existing installations shall be 4.5 except for horizontal return tubular boilers having continuous longitudinal lap seams more than 12 feet in length where the factor of safety shall be 8, and when this latter type of boiler is removed from its existing setting, it shall not be reinstalled for pressures in excess of 15 psig.

b) Reinstalled or secondhand boilers shall have a minimum factor of safety of 6 when the longitudinal seams are of lap riveted construction, and a minimum factor of safety of 5 when the longitudinal seams are of butt and double strap construction.

c) The maximum allowable working pressure for a vessel in operation shall be computed with the appropriate formulas in the ASME Code, using dimensions actually determined by the inspection for the thickness and twice the estimated corrosion allowance before the next inspection, and making suitable allowance for the other loadings enumerated in the ASME Code to

be considered in the design of a vessel. The maximum allowable working pressure of vessels designed and built with one or more openings, for which the closures are auxiliary equipment not part of the pressure vessels, shall be determined only after due consideration of the auxiliary equipment to be used as closures. The minimum factor of safety shall not be less than 4 and shall increased by the inspector if the condition and safety of the vessel demand it. The condition of the vessel and the particular service to which it is subject shall be the determining factors.

10.5 Factor of Safety. The factor of safety is "built in" to the modern ASME Code formulas of Section I, PG-27.1 through PG-27.4. For reference, the original formula is:

EQUATION: $P = (TS \times t \times E) / (R \times FS)$

where

P = pressure in psi
TS = tensile strength, psi
t = thickness, inches
E = efficiency of the longitudinal seam
R = inside radius, inches
FS = factor of safety

## Section 11: MISHAP OR PROPERTY DAMAGE REPORTING

11.1 Reporting Requirements. OPNAVINST 5102.1C, Mishap Investigation and Reporting, requires that incidents which satisfy the following criteria be reported to the activity Safety Office for investigation and reporting to the Naval Safety Center:

a) Damage to property involving a repair or replacement cost equal to or exceeding $10,000.

OR

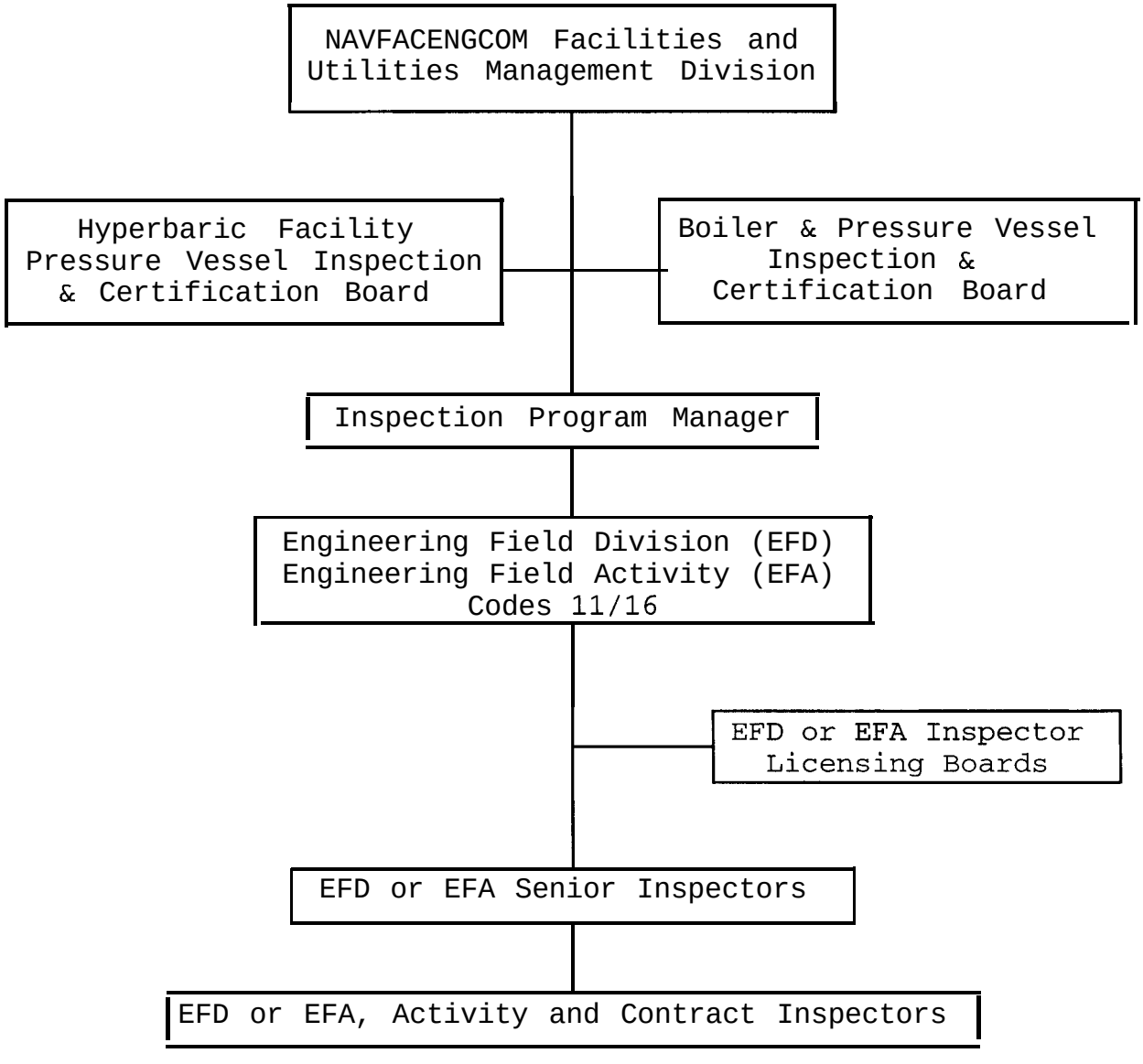
b) Any incident involving a lost time employee mishap.

This instruction also encourages reporting of incidents where serious injury to Navy personnel was possible or if there was a "lesson to be learned".

11.2 Information Copies. A copy of the required report for all incidents relating to the construction, repair, operation and maintenance of the boilers and unfired pressure vessels covered by this handbook shall be forwarded to the geographic EFD or EFA for information.

# Appendix A

## THE NAVFACENGCOM BOILER AND PRESSURE VESSEL INSPECTION PROGRAM QUALITY ASSURANCE ORGANIZATION



# Appendix B

## DUTIES AND QUALIFICATIONS OF THE SENIOR INSPECTOR AT THE NAVFAC EFDS OR EFAS

The duties of the Senior Inspector at each EFD or EFA are as follows:

1. Monitor status of inspections at all activities.

2. Perform random checks on contractor inspections.

3. Accompany all activity and EFD or EFA inspectors on an inspection at least once every 2 years.

4. Provide consultation services to EFD or EFA and activity inspectors.

5. Review all inspection reports.

6. Coordinate boiler water and clean steam programs with the Boiler and Pressure Vessel Inspection Program.

7. Provide liaison with the NAVFACENGCOM inspection program coordinator.

8. Conduct workshops for inspectors once every 2 years.

9. Coordinate inspections of new boilers and pressure vessels as requested by NAVFAC ROICCs.

10. Propose changes to MIL-HDBK-1152.

11. Attend Senior Inspector workshops.

12. Ensure activities correct safety violations.

13. Enlist NAVFAC support for correction of violations when necessary.

14. Void boiler and unfired pressure vessel inspection certificates when appropriate.

The qualifications of the Senior Inspector at EFDs or EFAs shall be as follows:

1. Posses a valid NAVFAC Boiler Inspector Certificate of Competency.

2. Possess a valid EFD or EFA Boiler Inspector's License.

3. Have at least 5 years experience in the inspection of high pressure power boilers.

# Appendix C

## PROCEDURES FOR LAY-UP OF BOILERS

C.1 Guidance. When a boiler is taken out of service, the boiler should be cooled until the water is below the atmospheric boiling point, but not below 180 degrees F; the boiler should be emptied and flushed out. An inspection should be made to determine what repair work is necessary and what mechanical and chemical cleaning should be done. A decision should then be made on whether to employ dry storage or wet storage. Since freshly cleaned metal surfaces are much more vulnerable to corrosion than surfaces that have operational oxides on them, it is much preferred to delay chemical cleaning until the boiler is ready to be returned to service.

C.2 Dry Storage. This procedure is preferred for boilers out of service for extended periods of time or in locations where freezing temperatures may be expected during standby.

C.2.1 The boiler should be thoroughly dried, since any moisture left on the metal surface would cause corrosion to occur on long standing. After drying, precautions should be taken to preclude entry of moisture in any form from steam lines, feed lines, or air.

C.2.2 Moisture absorbing material, such as quicklime at the rate of 2 pounds, or silica gel at the rate of 5 pounds, for 30 cubic feet of boiler volume, is placed on trays inside the drums to absorb moisture from the air. The manholes should then be closed and all connections on the boiler should be tightly blanked. The effectiveness of materials for such purposes and need for their renewal may be determined through regular internal boiler inspections.

C.2.3 Alternatively, air dried externally to the boiler may be circulated through it. The distribution should be carefully checked to be sure the air flows over all areas.

C.2.4 It is usually desirable in the case of large utility boilers (particularly the once-through type) to simply drain the boiler while feeding nitrogen to the boiler vents and maintaining a 5-psig nitrogen pressure during the storage period.

C.3 Wet Storage. A wet procedure may be used for a boiler to be placed in a standby condition. Wet storage is particularly useful if the standby boiler may be required for service at short notice or it is impractical to employ a dry storage procedure. The method is not generally employed for reheaters or for boilers which may be subject to freezing temperatures. Several procedures have been employed.

C.3.1 The empty boiler should be closed and filled to the top with water conditioned chemically to minimize corrosion during standby. Water pressure greater than atmospheric should be maintained within the boiler during the storage period. A head tank may be connected to the highest vent of the boiler to maintain a pressure above atmospheric.

C.3.2 For a short storage period, condensate or feedwater containing approximately 100 to 200 ppm of sodium sulfite may be used. If the superheater is of the drainable type, it can also be filled with the same treated water by overflow from the boiler.

C.3.3 If the superheater is not drainable, refer to the plant operating manual or request assistance from your cognizant EFD or EFA.

C.4 Alternative Wet Lay-Up Methods. The boiler may be stored with water at a normal operating level in the drum and nitrogen maintained at greater than atmospheric pressure in all vapor spaces. To prevent in-leakage of air, it is necessary to supply nitrogen at the vents before the boiler pressure falls to zero as the boiler is coming off line. If boiler pressure falls to zero, the boiler should be fired to reestablish pressure and the superheater and reheater thoroughly vented to remove air before nitrogen is admitted. All partly filled steam drums and superheater and reheater headers should be connected in parallel to the nitrogen supply. If nitrogen is supplied only to the steam drum, nitrogen pressure should be greater than the hydrostatic head of the longest vertical column of condensate that could be produced in the superheater. Rather than maintain the water in the boiler at normal operating level with a nitrogen cap, it is sometimes preferable to drain the boiler completely, applying nitrogen continuously during the draining operation and maintaining a pressure of nitrogen greater than atmospheric throughout the draining and subsequent storage.

# Appendix D

# REPORTS AND FORMS

## INSPECTION REPORT-BOILER

| | | | | |
|---|---|---|---|---|
| EXP DATE<br>DATE OF INSPECTION | A. ( ) INTERNAL - WATERSIDE ( ) FIRESIDE ( )<br>B. ( ) PRESSURE TEST - STRENGTH ( ) TIGHTNESS ( )<br>C. ( ) EXTERNAL/OPERATIONAL | | | |
| NEXT WATERSIDE INSPECTION DUE: | | | NEXT STRENGTH TEST DUE: | |
| 1. FROM: | | | 14. CERTIFICATE ISSUED | |
| 2. TO: | | | 15. BOILER INSPECTOR | |
| 3. MANUFACTURER: | | | NAVFAC No. LICENSE No. | |
| 4. PROPERTY No. | 5. MFG SERIAL No. | 6. MFG MODEL No. | 16. REASON FOR NOT ISSUING A | |
| | | | | |
| 10. NATIONAL BOARD NUMBER | 11. PRESSURE<br>DESIGN OPER. TEST | | | |
| 12. TYPE OF FUEL | 13. TYPE OF BOILER | | | |
| 17. FEEDWATER TREATMENT | | | | |
| 20. COMBUSTION<br>% CO2 CO (ppm) % EXCESS O2 | | | 21. FLUE GAS TEMPERATURE<br>degrees F | |

### SAFETY DEVICES/SAFETY VALVES

| 22. MANUFACTURER | 23. NUMBER | 24. SIZE | 25. PSI SETTING | 26. CONDITION |
|---|---|---|---|---|
| | | | | |

### FIRING EQUIPMENT

| | IN SERVICE | ALTERNATE |
|---|---|---|
| 27. | MANUFACTURER | MANUFACTURER |
| 28. | TYPE | TYPE |
| 29. | FUEL TYPE | FUEL TYPE |

30. INSPECTOR'S COMMENTS

| 31. ATTACHMENTS | 32. SIGNATURE |
|---|---|
| | |

## Instructions for Completing Inspection Report - Boiler

Use a separate form for each boiler. The following subparagraph numbers refer to number blocks on the report.

1. From: Enter the name of inspection department performing the inspection.

2. To: Enter the title of the activity for whom the inspection is being made.

3. Manufacturer: Enter the name of the manufacturer.

4. Property No.: Enter the identification number as indicated by the activity.

5. Manufacturer's Serial No.: Enter the serial number as indicated by the manufacturer.

6. Manufacturer's Model No.: Enter the model number as indicated by the manufacturer.

7. Building No.: Enter the building or structure number in which the boiler is located.

8. Year Built: Indicate the calendar year in which the boiler was constructed.

9. Capacity: Show capacity in millions of Btus per hour. One (1) pound per hour of steam is approximately equal to 1,000 Btus. One (1) boiler horsepower is approximately equal to 33,500 Btus per hour.

10. National Board Number: Enter the boiler National Board Number

11. Pressure: Enter the design, operating, and test pressures (psig).

12. Fuel: Enter appropriate fuel, e.g., natural gas, No. 2 to 6 fuel oil, propane, coal, solid waste, etc.

13. Type: Enter type of boiler, e.g., cast iron, watertube, firetube.

14. Certificate Issued: Enter yes or no.

15. Boiler Inspector: Signature of authorized inspector. Indicate the Navy Certificate of Competency number and/or EFD License to Inspect. Contract inspectors are to indicate their EFD Authorization to Inspect.

16. Reason for Not Issuing Certificate: Enter the reason for not issuing the certificate.

17. Boiler Feedwater Treatment: Enter if treatment is Satisfactory or Unsatisfactory.

18. Boiler Use: Enter the primary purpose of the boiler (space heating, power generation, cogeneration, process load, etc.).

19. Combustion Control: Enter the combustion control manufacturer and indicate if automatic or semi-automatic.

20. Combustion: Enter appropriate percentages.

21. Flue Gas Temperature: Enter, in degrees Fahrenheit, the temperature of the flue gas immediately after the boiler.

22. Manufacturer: Enter the name of the safety valve manufacturer.

23. Number: Enter the number of the safety valves on the unit.

24. Size: Enter the size of the safety valves.

25. PSI Settings: Enter the lifting pressure of the safety valves.

26. Condition: Enter the condition of the safety valve or valves as Satisfactory or Unsatisfactory.

27. Manufacturer: Enter the name of the primary fuel firing equipment manufacturer in column 1 and the alternate fuel in column 2.

28. Type: Enter the type of firing equipment (including the alternate).

29. Fuel Grade: Enter the primary and secondary fuel types, grade, e.g., natural gas, No. 2 fuel oil, No. 6 fuel oil, etc.

30. Inspector's Comments: Enter any comment regarding boiler discrepancies, etc.

31. Attachments: Enter yes or no.

32. Signature: Signature of Commanding Officer or other person authorized to forward the report.

## UNFIRED PRESSURE VESSEL REPORT

| | | |
|---|---|---|
| EXP DATE<br>DATE OF INSPECTION | TYPE OF INSPECTION<br>A. ( ) INTERNAL ( ) EXTERNAL ( )<br>B. ( ) PRESSURE TEST<br>C. ( ) OPERATIONAL TEST | |
| 1. FROM: | | 12. CERTIFICATE ISSUED |
| 2. TO: | | 13. BOILER INSPECTOR |
| 3. MANUFACTURER: | | NAVFAC No. LICENSE No. |
| 4. PROPERTY No. | 5. MFG SERIAL No. | 14. REASON FOR NOT ISSUING A |
| | | |
| | | |
| | | |

### SAFETY VALVES

| | | |
|---|---|---|
| 15. MANUFACTURER | 16. CAPACITY (CFM) | 17. NUMBER OF VALVES |
| 18. SIZE | 19. SETTING (PSI) | 20. VALVE CONDITION |
| 21. INSPECTOR'S COMMENTS | | |
| 22. ATTACHMENTS | 23. SIGNATURE | |

## Instructions for Completing Unfired Pressure Vessel (UPV) Report

Use a separate form for each UPV. The following subparagraph numbers refer to number blocks on the report.

1. Form: Enter the name of inspection department performing the inspection.

2. To: Enter the title of the activity for whom the inspection is being made.

3. Manufacturer: Enter the name of the manufacturer.

4. Property No.: Enter the identification number as indicated by the activity.

5. Manufacturer's Serial No.: Enter the serial number as indicated by the manufacturer.

6. Building No.: Enter the building or structure number in which the UPV is located.

7. Year Built: Indicate the calendar year in which the UPV was constructed.

8. National Board Number: Enter the vessel National Board Number

9. Pressure: Enter the design, operating, and test pressures (psig).

10. Capacity: Enter capacity in cubic feet.

11. UPV Use: Enter the primary purpose of the UPV (shop air, control air, etc.).

12. Certificate Issued: Enter yes or no.

13. Boiler Inspector: Signature of authorized inspector. Indicate the Navy Certificate of Competency number and/or EFD or EFA License to Inspect. Contract inspectors are to indicate their EFD or EFA Authorization to Inspect.

14. Reason for Not Issuing Certificate: Enter the reason for not issuing the certificate.

15. Manufacturer: Enter the name of the safety valve manufacturer.

16. Safety Valves Capacity (CFM): Enter capacity of valves.

17. Number of Valves: Enter the number of safety valves.

18. Size of Safety Valves: Enter the size of the safety valves in inches.

19. Setting (PSI): Enter safety valve setting.

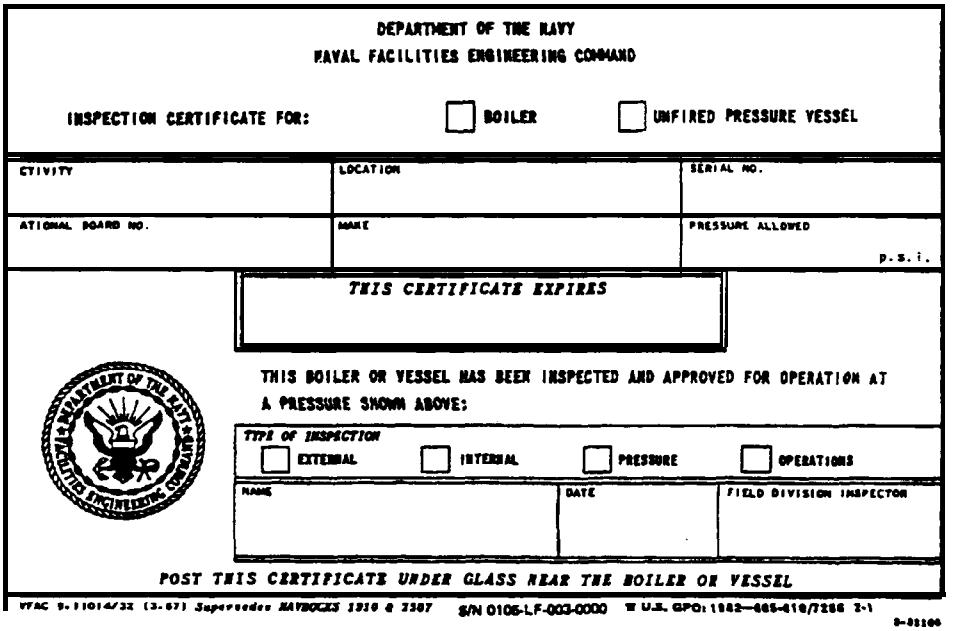
20. Valve Condition: Enter Satisfactory or Unsatisfactory.

21. Inspector's Comments: Enter any comment regarding UV discrepancies, etc.

22. Attachment: Enter yes or no.

23. Signature: Signature of Commanding Officer or other person authorized to forward the report.

Inspection Certificate for Boiler-Unfired Pressure Vessel
Form, NAVFAC 9-11014/32



DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND

INSPECTION CERTIFICATE FOR: ☐ BOILER ☐ UNFIRED PRESSURE VESSEL

| CTIVITY | LOCATION | SERIAL NO. |
|---|---|---|
| ATIONAL BOARD NO. | MAKE | PRESSURE ALLOWED p.s.i. |

THIS CERTIFICATE EXPIRES

THIS BOILER OR VESSEL HAS BEEN INSPECTED AND APPROVED FOR OPERATION AT A PRESSURE SHOWN ABOVE:

TYPE OF INSPECTION ☐ EXTERNAL ☐ INTERNAL ☐ PRESSURE ☐ OPERATIONS

| NAME | DATE | FIELD DIVISION INSPECTOR |
|---|---|---|
| | | |

POST THIS CERTIFICATE UNDER GLASS NEAR THE BOILER OR VESSEL

VFAC 9-11014/32 (3-67) *Supersedes NAVDOCKS 1910 & 2307* S/N 0105-LF-003-0000 ☆ U.S. GPO: 1982—665-410/7256 2-1

9-03104

## Instructions for Completing Inspection Certificate for Boiler - Unfired Pressure Vessel Form, NAVFAC (11014/32)

1. Inspection Certificate for: Place “xx” in appropriate box.

2. Activity: Name of activity.

3. Location: City and state.

4. Serial No.: Manufacturer's number from nameplate.

5. National Board No.: When available.

6. Make: Manufacturer's name.

7. Pressure Allowed: Taken from nameplate unless reduced as a result of inspection.

8. This Certificate Expires: Month and year of expiration depending on inspection frequency.

9. Type of Inspection: Place “xx” in appropriate box or boxes.

10. Name: Inspector will sign here.

11. Date: Date of signature.

12. Inspector: Will place his National Board Number or NAVFAC Certificate of Competency Number and EFD or EFA license (Authorization to Inspect) here.

# Appendix E

# PMI CHECKLISTS FOR SMALL BOILERS

## PMI CHECKLIST FOR STEAM BOILERS
(Capacities of 400,000 Btu/Hour Input or Less)

STEAM BOILERS

| | |
|---|---|
| 1. Observe condition of flame. Correct if flame is smoky or if burner starts with puff. Flame should not impinge on furnace walls. | Weekly |
| 2. Test the low water fuel cutoffs for proper sequencing and operation. Blow down boiler. | Weekly |
| 3. Test water column or gage glass. Glass must be clean and free of obstructions. Clean dirty glass and replace defective column or glass at once. Defects include leaking gage cocks and glass, excessive corrosion, inability to discern water level, and improper operation. | Weekly |
| 4. Observe operation of condensate or vacuum pumps. Replace or repair defective or leaking pumps. | Weekly |
| 5. Check operation of chemical feed pots and feed pumps. Repair or replace defective equipment. | Weekly |
| 6. Test flame detection devices and associated automatic fuel cutoff valves. Loss of flame should shut off flow of fuel to the burner. Repair or replace if device or valves are found to be defective. | Monthly |
| 7. Inspect steam supply and condensate return piping, valves, radiators, and traps for leaks, excessive rust, and damage or lack of insulation. Blow down strainers. Repair or replace individual items as needed. | Monthly |

| | |
|---|---|
| 8. Inspect fuel supply systems and piping in boilers for leaks, loss of insulation, etc. Repair or replace as needed. Replace cartridges for in-line oil filters. Adjust oil pressure as prescribed by the manufacturer. Ensure both oil supply and return lines have a fusible in-line valve. | Monthly |
| 9. Check condition of safety valves. Test valve with tri-lever. Valves should preferably be the pressure type. Leaking safety valves must be replaced. No obstruction such as another valve, long pipe length, or constriction is permissible between the boiler and the safety valve. The overflow from the valve should be free of obstructions and piped to within 4 inches of the floor or to a floor drain. | Monthly |
| 10. Check boiler room drains for proper functioning. | Monthly |
| 11. Inspect burner assembly. Evidence of improper fuel nozzle wear, plugging, or carbon buildup on the nozzle is cause for replacement. Adjust equipment for proper combustion after replacing the old nozzle with a new one. | Monthly |
| 12. Inspect burner assembly. Replace nozzle and filters on oil burning equipment. Clean, check, and adjust electrodes. | Annually |
| 13. Inspect internal and external heating surfaces after cleaning. Fireside surfaces should be free of soot. Cracked surfaces will require repair or replacement of the furnace (firing chamber). Repair to pressure parts requires a certified welder. Evidence of bulges or other deformities indicate defective controls and safety devices or improperly sized and adjusted burner. Consult a boiler water treatment specialist if there is evidence of hard scale on the waterside surfaces. | Annually |
| 14. Inspect gas piping and valves regularly for proper support and tightness. Test for tightness with a soap solution. If a leak is detected, then secure the piping to the boiler and contact the gas company. | Annually |

| | |
|---|---|
| 15. Check the transformer. Do not interchange transformers of different capacities when replacing defective transformers. | Annually |
| 16. Remove trash and any combustibles from the boiler room. Assure proper ventilation to the boiler. | Annually |
| 17. Check draft, manifold pressure, and combustion. Conduct combustion efficiency test and adjust burner for efficient and safe operation. Combustion measurements required are for CO%, CO2%, 02%, stack temperature, and boiler room temperature. No smoke or CO should be evident. Overfire draft should be at least 0.02 inches water gage (W.G.) for oil burners. Adjust manifold pressure as specified by the manufacturer. | Annually |
| 18. Inspect control equipment for proper sequence and operation. Covers on controllers should be in place. Dust and dirt on control equipment must be removed. Electric contacts that are fouled require cleaning. All wiring should be properly grounded. | Annually |
| 19. Calibrate and check operation of gages and meters. Repair or replace all defective gages and meters. Defects include cracked, broken, or dirty glass, illegible markings, and bent pointers. Place date and initials of tester on the face of the calibrated gages. | Annually |
| 20. Check breaching and stack for integrity and tightness. Breaching and stack should be firmly attached to the boiler in forced draft systems. The breaching and stack should be properly supported and either vertical or sloped upward. | Annually |
| 21. Check shell for cleanliness, excessive rust, corrosion streaks, or any deformations and cracks. Clean and repair. Repaint to cover bare metal. Assure access doors are in place and in working order. | Annually |

HOT WATER BOILERS

| | |
|---|---|
| 1. Observe condition of flame. Correct if flame is smoky or if burner starts with a puff. Flame should not impinge on the furnace walls. | Weekly |
| 2. Check fuel supply (oil). Note level of oil in tank. Leaking tanks must be repaired or replaced immediately. | Weekly |
| 3. Observe operation of circulating pumps. Lubricate pump motor, bearing assembly, and flex coupling. Noisy pump motors require repair or replacement. | Weekly |
| 4. Test flame detection devices and associated automatic fuel cutoff valves. Loss of flame should shut off flow of fuel to the burner(s). Replace or repair if device or valves are found defective. | Monthly |
| 5. Inspect fuel supply systems and piping in boilers for leaks, loss of insulation, etc. Repair or replace as needed. Replace cartridges for in-line oil filters. Adjust oil pressure as prescribed by the manufacturer. Ensure both oil supply and return lines have a fusible in-line valve. | Monthly |
| 6. Check boiler room drains for proper functioning. | Monthly |
| 7. Check condition of safety relief valves. Test valve with tri-lever. Valves should preferably be the pressure and temperature type. Leaking safety valves must be replaced. No obstructions such as another valve, long pipe length, or constriction is permissible between the boiler and the safety valve. The overflow from the valve should be free of obstructions and piped to within 4 inches of the floor or to a floor drain. | Monthly |
| 8. Inspect burner assembly. Evidence of improper fuel nozzle wear, plugging or carbon buildup on the nozzle is cause for replacement. Adjust equipment for proper combustion after replacing the old nozzle with a new one. | Monthly |

| | |
|---|---|
| 9. Inspect burner assembly. Replace nozzle and filters on oil burning equipment. Clean, check, and adjust electrodes. | Annually |
| 10. Inspect internal and external heating surfaces after cleaning. Fireside surfaces should be free of soot. Cracked surfaces will require repair or replacement of the furnace (firing chamber). Repair to pressure parts requires a certified welder. Evidence of bulges or other deformities indicates defective controls and safety devices or improperly sized and adjusted burner. Consult a boiler water treatment specialist if there is evidence of hard scale on the waterside surfaces. | Annually |
| 11. Inspect gas piping and valves regularly for proper support and tightness. Test for tightness with a soap solution, never a flame. If a leak is detected, then secure piping to the boiler and contact the gas company. | Annually |
| 12. Check transformer. Do not interchange transformers of different capacities when replacing defective transformers. | Annually |
| 13. Inspect area around boiler for cleanliness, combustibles, etc. Remove trash and any combustibles from the boiler room. Assure adequate ventilation to the boiler. | Annually |
| 14. Inspect hot water supply and return piping, valves, and dual control units for leaks, excessive rust, and damaged or missing insulation. Repair or replace as needed. | Annually |
| 15. Check draft, manifold pressure, and combustion. Conduct combustion efficiency test and adjust burner(s) for efficient safe operation. Combustion measurements required are CO%, CO2%, O2%, stack temperature, and boiler room temperature. No smoke or CO should be evident. Overfire draft should be at least 0.02 inches water gage (W.G.) for oil burners. Adjust manifold pressure as specified by the manufacturer. | Annually |

16. Check expansion tank and air eliminator equipment for leaks, corrosion, etc. Repair or replace defective equipment. Annually

17. Inspect control equipment for proper sequence and operation. Covers on controllers should be in place. Dust and dirt on control equipment must be removed. Electric contacts that are fouled require cleaning. All wiring should be properly grounded. Annually

18. Calibrate and check operation of gages and meters. Repair or replace all defective gages and meters. Defects include cracked, broken, or dirty glass, illegible markings, and bent pointers. Place date and initials of tester on the face of the calibrated gages. Annually

19. Check breaching and stack for integrity and tightness. Breaching and stack should be firmly attached to the boiler in forced draft systems. The breaching and stack should be properly supported and either vertical or sloped upward. Annually

20. Check shell for cleanliness, excessive rust, corrosion streaks, deformations, and cracks. Clean and repair as necessary. Repaint to cover bare metal. Assure access doors are in place and in working order. Annually

# Appendix F

## WHAT TO EXPECT WHEN THE BOILER INSPECTOR CALLS

The following article is reprinted unabridged with the permission of HEATING, PIPING, and AIR CONDITIONING. The author is John G. Gillissie, a field representative of the National Board of Boiler and Pressure Vessel Inspectors.

The article is provided as a general guide for use by activities when preparing boilers for inspection. The text of MIL-HDBK-1152 contains further guidance.

## WHAT TO EXPECT WHEN THE BOILER INSPECTOR CALLS

Here's what you can and should do to help him to ensure the safety and integrity of your boiler plant.

Boilers are so common and essential that their safe and effective operation can easily be taken for granted. With boiler safety laws widely adopted and enforced, boiler accidents have become relatively rare. Yet the potential for injury and destruction still exists with any boiler or pressure vessel. A careful, consistent program of maintenance and third-party inspection is fundamental to boiler safety.

That's why you, as a boiler owner or user, can count on periodic visits from an inspector commissioned by the National Board of Boiler and Pressure Vessel Inspectors and authorized by the legal jurisdiction in which you operate. His visit is mandated by the police powers of that jurisdiction to maintain public safety.

Here is what to expect-and what you can and should do to help-when the authorized inspector visits you, based on the National Board Inspection Code.

Boilers bearing the ASME and National Board stamps are inspected during manufacture by a National Board commissioned inspector to assure conformance to the ASME Boiler and Pressure Vessel Code. They are then inspected at installation and at designated periods thereafter, depending on the regulations that govern your area. Because thorough boiler inspections are essential, the following directions for them have been carefully drawn up. In some cases, these instructions appear as recommendations in the National Board Inspection Code although your local regulations probably make them mandatory.

The commissioned inspector visiting you will know these regulations and will understand what causes boiler deterioration and accidents. He will be conscientious and careful in his observations, taking sufficient time to make his examination thorough in every way and making no final statement about conditions not personally observed. He will not accept testimony of others. If he cannot make a thorough inspection, he will note that in his report.

The inspector will request that you, as the owner, or your representative be present during the inspection. He may request you or your representative to aid in any physical tests necessary to evaluate the boiler's physical condition.

The inspector will begin by observing the condition of your entire boiler installation, forming an opinion of the care the equipment receives. On entering the boiler area, he will first inspect the boiler externally. The general cleanliness and accessibility of the boiler and its auxiliary apparatus will be noted.

Boiler fittings, valves, and piping will be checked. Any steam or water leak-such as leakage coming from behind insulation, coverings, supports, or settings-or any evidence of leakage will be thoroughly investigated and any necessary corrective action pointed out. You may be asked to remove insulation to locate the source of leakage or to determine the extent of suspected corrosion.

## POWER BOILER INSPECTION

External inspection of power boilers (operating pressures greater than 15 psig) is slightly different from that of heating boilers. For power boilers, the inspector will compare the pressure indicated on the pressure gauge with readings on other gauges in the same system or, if necessary, with a standard test gauge. He will observe the readings during tests, such as the reduction in pressure when testing the low water fuel cutoff control. Defective gauges must be replaced.

Next, the inspector will observe the blowdown of the water gauge in the normal manner and how promptly the water returns. A sluggish response may indicate an obstruction in the pipe connection to the boiler, which must be corrected. During the water level gauge test, water and steam connections will be blown separately to ensure both are clear. The inspector will also determine that the boiler water level indication is accurate.

Safety valves come next. The inspector will check the nameplate data of the safety valves to assure that they are ASME/National Board certified and that their relieving capacity is sufficient to safeguard the boiler under full firing conditions. He will also assure that factory seals have not been broken. If the set pressure does not exceed 400 psi, safety valves are tested by

allowing the boiler pressure to rise to the popping pressure and subsequently fall.

If checking the actual popping pressure and blowdown is not practical, the boiler operator, while being observed by the inspector, will test the valve for free operation by using the lifting lever, provided the boiler pressure is 75 percent or more of the set pressure. This method is the only practical way to test multiple safety valves unless an accumulation test is made.

At pressures above 400 psi, evidence must be shown that the valves were tested under pressure or dismantled, overhauled, and tested and their popping pressures and blowdown adjusted where necessary within a reasonable period of time acceptable to the inspector. Your best assurance that the safety valves have been properly repaired or refurbished is to have this work carried out by an organization that holds a National Board “VR” (safety valve repair) certificate of authorization.

Alternatively, the owner or user may elect to make the actual popping test just described. If the valve has a discharge pipe, the inspector will determine whether the drain opening in the pipe is free to an atmospheric exhaust area.

When inspection reveals that a safety valve is leaking, sticking, or not opening and closing properly, the boiler will be taken out of service. The valve must then be replaced or repaired.

The inspector will next observe how the low water fuel cutoff or feed controls respond when the drain is opened; he will check how promptly the system returns to normal, as when the alarm or the feed pump stops. A sluggish response may indicate an obstruction in the pipe connections to the boiler. If the controls, where provided, are inoperative or the correct water level is not indicated, the boiler will be taken out of service until the unsafe condition has been corrected.

Piping, connections, and fittings will also be carefully examined by the inspector to ensure that there is provision for expansion and adequate support. Steam and water piping and fittings will be examined for leakage. Any leakage or other defects must be corrected. (To avoid water hammer, the locations of the various stop and drain valves should not allow water to accumulate when the valves are closed.) Excessive vibration will be noted and corrective action required.

Connections between individual boilers and the main steam header will be checked for strain caused by the boilers' changing position due to settling or other causes. The inspector will verify that all pipe connections and fittings are properly rated for the service conditions they encounter. He will also observe the blowdown of the boiler in the normal manner, check for freedom of the piping to expand and contract, and ensure that there is no excessive vibration.

During all tests, the inspector will determine whether the actual operating and maintenance practices he observes are acceptable. He will discuss any defects or deficiencies in the boiler or in operating and maintenance practices with the owner or user at this time and recommend corrections.

## INTERNAL INSPECTIONS

Since most internal conditions to be observed by the inspector are common to both power and heating boilers, the internal inspection procedures are essentially the same for both types. (Remember, when a boiler is to be prepared for internal inspection, the water must not be withdrawn until the setting has been sufficiently cooled at a rate to avoid damage to the boiler.)

The owner or user should follow these steps to prepare a boiler for internal inspection:

1) Draw off all water and thoroughly wash out the waterside.

2) Remove manhole and handhole plates, washout plugs, and inspection plugs in water column connections as required by the inspector. Cool and thoroughly clean the furnace and combustion chambers.

3) Remove all grates from internally fired boilers.

4) Remove insulation and brickwork as designated by the inspector to determine the condition of the boiler, headers, furnace, supports, or other parts.

5) Remove the pressure gauge for testing when required by the inspector.

6) Steam or hot water leakage into the boiler can be prevented by disconnecting the pipe or chain locking the valves at the most convenient point or by other means approved by the inspector.

7) Before the manhole or manholes are opened and the inspector enters any part of a boiler connected to a common header with other boilers, close, tag, and preferably padlock the required steam or water system stop valves and open the freeblow drain valves or cocks between the two closed stop valves. Disconnect blowoff lines, where practical, between pressure parts and valves. Open all drains and vent lines.

8) Before internal inspection is begun, the owner or user must determine that the boiler is safe to enter, is adequately ventilated, and contains no harmful vapors. Applicable safety rules and local regulations must be followed. A person should also stand by the boiler all the time the inspector is inside.

With preparations complete, internal inspection begins with insulation and brickwork. Removing boiler insulation material, masonry, or fixed parts for inspection is not normally necessary unless defects or deterioration are suspected or are commonly found in the particular type of boiler being inspected. If evidence of leakage shows on the covering, the insulating material, masonry, or a fixed part of the boiler may require removal to ensure a thorough inspection. Even drilling or cutting away parts may be necessary.

The boiler temperature must be low enough to ensure that inspecting personnel will not be exposed to excessive heat. If a boiler has not been properly prepared for an internal inspection, the inspector will decline to proceed. The inspector begins the detailed internal inspection by first examining all exposed metal surfaces on the waterside of the boiler for deposits caused by water treatment, scale, oil, or other substances. Oil or scale in the tubes of watertube boilers or on the plates over the fire in any boiler is particularly detrimental. It can have an insulating effect that can lead to overheating, weakening, and possible metal failure by bulging or rupture. Since even the smallest amount of oil is dangerous, immediate steps must be taken to clean the affected surfaces and prevent further contamination, using chemical or mechanical means as appropriate.

The inspector will examine all stays to determine whether or not they are in even tension. All fastened ends will be examined for cracks. Stays or stay bolts not in tension or adjustment must be repaired. Broken stays must be replaced. He will test firebox stay bolts by tapping one end of each bolt with a hammer. Stay bolts with holes will be examined for evidence of leaks, which indicate a broken or cracked stay bolt. Broken stay bolts must be replaced.

Manholes and reinforcing plates, as well as nozzles or other connections flanged or screwed into the boiler, will be examined both internally and externally. Whenever possible, observation will be made from the inside to determine whether connections to the boiler are properly made.

All openings leading to external attachments-such as water column connections, low water fuel cutoff devices, openings in drypipes, and openings to safety valves-will be examined to ensure they are free from obstruction.

The inspector will also check fire surfaces for bulging or blistering. Bulges often result from overheating of the entire thickness of the metal, lowering the strength of the metal and allowing it to be deformed by the pressure in the boiler. Bulges may also be caused by creep or temperature gradients.

Blisters may be caused by metal defects, such as lamination in which the side exposed to the fire overheats but the opposite side retains its strength due to the cooling effect of the boiler water. Overheating can cause serious boiler deterioration. Metal parts can oxidize, and pressure parts can deform and even rupture. Tubes can also be damaged by poor circulation, steam binding, or deposition of scale.

The inspector will pay particular attention to the plate or tube surfaces exposed to the fire, looking for any deformation such as bulging or blistering. If a bulge or blister shows evidence of leakage or is large enough to weaken the plate or tubes seriously, the boiler will be put out of service for repair. The blister area must be removed, the remaining thickness determined, and repairs made as required. Although a bulge on a water tube must always be repaired, a bulge on a plate, if not extensive, can be driven back into place. Otherwise the affected area must be patched.

Another type of flaw noted by the inspector is cracking. Cracks can result from flaws originating in the material from which the boiler was made, the boiler's basic design and operating conditions, or metal fatigue. They can be accelerated by corrosion. Fire cracks are caused by the thermal differential when the cooling effect of the water is not adequate to transfer the heat from the metal surfaces exposed to the fire. Cracks can result from a combination of these causes. Cracks noted in shell plates usually are dangerous.

The inspector will examine areas where cracks are most likely to appear, such as the ligaments between the tube holes on watertube boiler drums, between the tube holes on the tube sheet of firetube boilers, areas of stay bolts, at any flange where there may be repeated flexing of the plate during operation, and around welded pipe and tube connections.

If cracks are suspected, a hydrostatic test to determine their location may be necessary. A suitable nondestructive examination method may also locate such cracks.

The inspector will also look for corrosion, which causes metal surface deterioration. Corrosion can affect large areas or be localized as pitting. Isolated, shallow pitting is not considered serious if it is not active.

Boiler corrosion is usually caused by free oxygen and dissolved salts. If the inspector finds active corrosion, he will advise the owner or user to obtain competent remedial action. To estimate what effect severe corrosion over large areas has on the safe working pressure, the thickness of the remaining sound metal will be determined by ultrasonic examination or by drilling.

Grooving, yet another type of flaw, is a metal deterioration caused by localized corrosion and stress concentration. The inspector will examine all flanged surfaces, particularly the flanges of unstayed heads, as thoroughly as their construction permits. Grooving in the knuckles of such heads is fairly common since they have a slight natural movement that causes a stress concentration.

Boilers with ogee or reversed flanged construction are also prone to grooving but may not be readily accessible for examination. The inspector will insert a mirror through an examination opening

to examine as much area as possible. Other examination methods, such as ultrasonics, may be employed. Since grooving is usually progressive, its effect must be carefully evaluated and corrective action taken when it is detected.

Firetubes, watertubes, and piping are examined next. The fireside surfaces of tubes in horizontal firetube boilers usually deteriorate more rapidly at the ends nearest the fire. The inspector will check the tube ends for serious reductions in thickness. The surfaces of tubes of vertical tubular boilers are more susceptible to deterioration at the ends exposed to combustion. These exposed tube ends in the combustion space will also be checked for serious reductions in thickness.

The inspector will thoroughly examine the waterside surface of all tubes for pitting and corrosion. In vertical firetube boilers, excessive corrosion and pitting often occur at and above the water level. Excessive scale on water surfaces must be removed before the boiler is placed back in service.

Watertube surfaces will be carefully examined for corrosion, erosion, bulges, cracks, or any evidence of defective welds. Tubes can become thinned by erosion produced by the impingement of particles of fuel and ash at high velocity or by improperly installed or operated soot blowers. Tube leaks frequently cause serious corrosion or erosion on adjacent tubes.

Fuel and ash also tend to lodge in restricted fireside spaces, as where short tubes or nipples join drums or headers. Such deposits usually cause corrosion if moisture is present. Coal and fuel oils contain sulfur, which is present in ash or soot deposits. Dampness adds hydrogen and exposure to air adds oxygen. The result is $H_2SO_4$, not helpful to metal surfaces. Clean this area thoroughly for the inspector’s examination.

The inspector will thoroughly examine piping, connections, and fittings for leaks and to ensure adequate provision for expansion and supports. Any leaks or other defects must be corrected. To avoid water hammer, stop and drain valves must be located so that water will not accumulate when the valves are closed. Excessive vibration and its effects must be corrected.

All automatic low water fuel cutoff and water feeding devices will be examined for proper installation. Operating instructions for the devices must be readily available. The inspector will

examine the float chamber type control devices for wear. Necessary repairs must be made before the devices are placed back into service.

He will further check that fireside baffles in watertube boilers are in place. If proper baffling is absent, high temperature concentrations often result, causing overheating in portions of the boiler. The location and condition of combustion arches will be checked to ensure flame impingement will not cause overheating. Any localized heat buildup caused by defective or improperly installed or operated firing equipment must be corrected before the boiler is returned to service.

The inspector will examine the supports and setting of suspended boilers, especially where a boiler is near the setting walls or floor, to ensure ash or soot does not bind or produce excessive strains on the boiler by restricting its movement when operating.

The National Board recommends that under normal operating conditions, safety valves installed on power boilers operating at 400 psi or less be manually tested once a month by the operator and pressure tested once a year. (Under certain operating conditions, these recommendations may not apply.) Actual operating experience will determine how frequently safety valves on power boilers operating at more than 400 psi should be tested.

The inspector will check safety and safety relief valves on heating boilers for the correct set pressure and adequate relieving capacity. Any leaking or deteriorated valve must be repaired by the manufacturer or an authorized safety valve repair facility or be replaced. Discharge pipes must be adequately supported, and valves must be properly sealed unless they are nonadjustable.

A common unsafe condition found in both safety and safety relief valves is the failure to open at the set pressure due to buildup of corrosive deposits between the disc and seat.

The National Board recommends that under normal operating conditions, the safety or safety relief valve on a steam or hot water heating boiler should be tested manually once a week and pressure tested once a year. Again, under certain operating conditions, these recommendations may not apply.

The inspector will next determine that where required, all pressure gauges have been removed and tested and their readings compared to the readings of a standard test gauge or a dead weight tester. He will determine whether any steam pressure gauge is exposed either to high temperature from an external source or to internal heat due to lack of protection by a proper siphon or trap. He will also check that provision is made for blowing out the pipe leading to the steam gauge.

If tubes have been replaced or re-rolled, the inspector will check for proper workmanship. If tubes are readily accessible, they may have been over-rolled. Conversely, if it is difficult to reach the tube ends, they may have been under-rolled. If the inspector requires additional information regarding a leak in a boiler or the extent of a possible defect, he may require that a hydrostatic test be performed. To determine tightness, the hydrostatic test pressure need be no greater than the set pressure of the safety valve having the lowest setting.

The hydrostatic test pressure may not exceed 1.5 times the maximum allowable working pressure. The safety spring may not be compressed to prevent the valve from opening. The safety valve or valves will be removed and each disc held down by means of a gag or testing clamp. A plug device designed for this purpose may be used. Water used in the hydrostatic test should be at least 70 degrees F but may not exceed 120 degrees F during the inspection. If a test is conducted at 1.5 times the maximum allowable working pressure and the owner specifies a temperature higher than 120 degrees F for this test, the pressure must be reduced to the maximum allowable working pressure and the temperature to 120 degrees F for close examination.

Finally, the inspector will review the boiler log and the records of maintenance and feedwater treatment to determine what regular tests have been made on the boiler and controls. He will consult the owner or user regarding any repairs made since the last inspection and will review such repairs for compliance with Chapter III of the National Board Inspection Code.

The inspector will discuss any defects or deficiencies in the condition or the operating and maintenance practices of the boiler and auxiliary equipment with the owner or user at this time and recommend any necessary corrective actions.

A National Board commissioned inspector is a well trained, experienced individual, who may be in the employ of your insurance carrier, a state of the United States, a province of Canada, or a large municipality. He offers you an independent evaluation of your boiler's physical condition. He will recommend only repairs or maintenance necessary to safeguard the integrity of your boiler. His prime interest is public safety. Listen to him and follow his advice.

# REFERENCES

NOTE: THE FOLLOWING REFERENCED DOCUMENTS FORM A PART OF THIS HANDBOOK TO THE EXTENT SPECIFIED HEREIN. USERS OF THIS HANDBOOK SHOULD REFER TO THE LATEST REVISIONS OF CITED DOCUMENTS UNLESS OTHERWISE DIRECTED.

FEDERAL/MILITARY SPECIFICATIONS, STANDARDS, BULLETINS, HANDBOOKS, AND NAVFAC GUIDE SPECIFICATIONS:

Unless otherwise indicated, copies are available from the Naval Publishing and Printing Service Office (NPPSO), Standardization Document Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MANUALS

| | |
|---|---|
| NAVFAC MO-225 | Industrial Water Treatment Manual |
| NAVSEA S9086-SY-STM-010 | Naval Ship’s Technical Manual |

MILITARY SPECIFICATION

| | |
|---|---|
| MIL-F-22606B | Flask Compressed Gas and End Plugs for Air, Oxygen, and Nitrogen |

OTHER GOVERNMENT DOCUMENTS AND PUBLICATIONS:

| | |
|---|---|
| CNO Ltr 10-22-70 | Inspections of Boilers, Unfired Pressure Vessels, Elevators, Dumbwaiters and Escalators |
| DLA Reg. No. 4145.25 | Storage and Handling of Compressed Gases and Liquids in Cylinders and of Cylinders |
| NAVFAC Form 9-11014/32 (3-67) | Inspection Certificates |
| NAVFAC Ltr 11370-02,1637 | Inspection and Certification of Boilers and Unfired Pressure Vessels |

OPNAVINST 5102.1C Mishap Investigation and Reporting

(Unless otherwise indicated, copies are available from Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.)

NON-GOVERNMENT PUBLICATIONS:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/ASME CSD-1 Controls and Safety Devices for Automatically Fired Boilers

(Unless otherwise indicated, copies are available from American Society of Mechanical Engineers, New York, NY.)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Boiler and Pressure Vessel Code

(Unless otherwise indicated, copies are available from American Society of Mechanical Engineers, New York, NY.)

NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTION

National Board Inspection Code

(Unless otherwise indicated, copies are available from the National Board of Boiler and Pressure Vessel Inspection, Columbus, OH.)

NATIONAL FIRE PROTECTION ASSOCIATION

National Fire Codes

(Unless otherwise indicated, copies are available from the National Fire Protection Association, Quincy, MA.)

# GLOSSARY

ASME: American Society of Mechanical Engineers

ABET: Accreditation Board for Engineering Technology

ANSI: American National Standards Institute

Boiler: A closed vessel intended for generating steam or other fluids (to be used externally to itself), under pressure or vacuum, by the direct application of heat from combustible fuels, electricity, or nuclear energy.

Boiler Auxiliary: Any equipment of the feedwater system and combustion air and fuel systems. This shall include feedwater pumps, feedwater heaters, and deaerators, evaporators, economizers, condensate receivers, fans, combustion air and fuel oil pre-heaters, fuel oil pumps, coal feeders, conveyers, hoppers, bins, pulverizers, dryers, and ash collection and removal equipment.

BPVC: Boiler and Pressure Vessel Code

Code: The Boiler and Pressure Vessel Code of the American Society of Mechanical Engineers with such revisions, amendments and interpretations thereof as are made, approved, and adopted by the Council of the Society. Copies of the Code may be obtained from the Society at 29 West 39th Street, New York City, N Y.

Condemned Boiler or Unfired Pressure Vessel: A boiler or unfired pressure vessel that has been inspected and declared unsafe, or disqualified by an inspector qualified to take such action who has applied a stamping or marking designating its rejection.

CFM: Cubic Feet per Minute

Design Pressure: The maximum allowable working pressure at the time the boiler or unfired pressure vessel was built.

DLA: Defense Logistics Agency

Domestic Hot Water Heater: A closed vessel which generates hot water of less than 210 degrees F.

DOT: Department of Transportation

EFA: Engineering Field Activity

EFD: Engineering Field Division

External Inspection: An inspection made of the external parts of a boiler or unfired pressure vessel under pressure, its appurtenances, and connections as specified by this handbook.

Firing Equipment: Any equipment provided to inject, move, or support fuel in the boiler furnace. This includes oil burners, gas burners, fuel injectors, fuel igniters, coal stokers and feeders, grates, and over-fire steam or air jets.

Fusion Welding: A process of welding metals in a molten, or molten and vaporous state, without the application of mechanical pressure or blows. Such welding may be accomplished by the oxyacetylene or oxyhydrogen flame or the electric arc. Thermit welding is also classed as fusion welding.

Heat Exchanger: An unfired vessel used to transfer heat from one medium to another.

Heating Boiler: A steam boiler operated at pressures not exceeding 15 psig or a low temperature hot water boiler.

High Pressure Power Boiler: A closed vessel in which steam or other vapor (to be used externally to itself) is generated at a pressure of more than 300 psig.

High Temperature Water (HTW) Boiler: A fired heat exchanger which heats water to a temperature in excess of 250 degrees F at a pressure above 160 psig.

High Temperature Water Heat Exchanger: An unfired water to water heat exchanger used to transfer heat from the primary high temperature hot water supply to a secondary loop.

Hydrostatic Test: The application of a pressure by means of water or other liquid to the various pressure parts of a boiler or unfired pressure vessel.

Hyperbaric Facility Pressure Vessels: Unfired pressure vessels which are intended to be occupied by personnel, animals, or test equipment during pressurization.

Installed Working Pressure: The pressure on the gage, at which the boiler or unfired pressure vessel is normally operated. Synonymous with operating pressure.

Internal Inspection: An inspection made when a boiler or unfired pressure vessel is shut down and handholes, manholes, or other inspection openings are opened for inspection of the fire, gas, air, and water sides as specified by this handbook.

Low Temperature Water (LTW) Boiler: A fired heat exchanger which heats water to a temperature below 250°F at a pressure below 160 psig.

LPG (liquid propane gas) Tank: A tank used to store LPG.

Major Repair: A repair upon which the strength of a boiler or unfired pressure vessel depends.

Maximum Allowable Working Pressure: The pressure indicated as such on the name-plate of a boiler or that determined by employing the factors of safety, stresses, and dimensions designated in the ASME code, whichever is lower. The term, maximum allowable working pressure, at the coincident metal temperature, permissible at the bottom of the vessel in its operating position and which is the basis for the upper limit in pressure setting of the safety relieving devices for any specific operation.

MUSE: Mobile Utility Service Equipment

NAVFACENGCOM: Naval Facilities Engineering Command

NBBI: National Board of Boiler and Pressure Vessel Inspection

NFPA: National Fire Protection Association

Nonstandard Boiler or Unfired Pressure Vessel: A boiler or unfired pressure vessel that does not bear the ASME stamp or the stamp of the National Board of Boiler and Pressure Vessel Inspectors.

Operating Pressure: The actual pressure at which the boiler or unfired pressure vessel operates. Synonymous with the term "installed working pressure."

PMI: Preventative maintenance inspection

Pneumatic Test: The application of pressure by means of air or other gases to the various parts of an unfired pressure vessel.

Portable Boiler: An internally fired boiler which is primarily intended for temporary location and the construction and usage of which is obviously portable. This category includes Navy "Mobile Utilities Support Equipment" (MUSE) boilers.

Power Boiler: A closed vessel in which steam or other vapor (to be used externally to itself) is generated at a pressure of more than 15 psig but not more than 300 psig by the direct application of heat.

PSI: Pounds per square inch

Psig: Pounds per square inch gage.

Reinstalled Boiler or Unfired Pressure Vessel: A boiler or unfired pressure vessel removed from its original setting and re-erected at the same location or erected at a new location without change of ownership.

Residential or Commercial Warm Air Furnace: A direct fired heat exchanger which is used to heat air for residential and commercial heating applications.

Safety Appliances: Any device providing protection for boiler or unfired pressure vessel against pressure of steam, vapor, air, water, or other liquid. This includes steam safety valves, fusible plugs, air, water or other liquid pressure relief valves, combination pressure-temperature relief valves, and rupture disks.

Second Hand Boiler or Unfired Pressure Vessel: A boiler or unfired pressure vessel of which both the location and ownership have been changed after primary use.

Standard Boiler or Unfired Pressure Vessel: A boiler or unfired pressure vessel which bears the ASME stamp, or the stamp of the NBBI.

Unfired Pressure Vessel (UPV): A closed vessel in which internal pressure is above or below atmospheric pressure, and pressure is obtained from an external source or from an indirect application of heat.

# INDEX

## A



## B



## C



## D



## E

F



G



H



I



L

M



N



P



Q



R

S



T



U



V



Y



CUSTODIAN
NAVY - YD2

PREPARING ACTIVITY
NAVY - YD2

PROJECT NO.
FACR-1165

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

| I RECOMMEND A CHANGE: | 1. DOCUMENT NUMBER: MIL-HDBK-1152 | 2. DOCUMENT DATE (YYMMDD) |
|---|---|---|

3. DOCUMENT TITLE Inspection and Certification of Boilers and Unfired Pressure Vessels

4. NATURE OF CHANGE *(identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

## 6. SUBMITTER

| a. NAME *(Last, First, Middle Initial)* | b. ORGANIZATION | |
|---|---|---|
| c. ADDRESS *(Include Zip Code)* | d. TELEPHONE *(Include Area Code)*<br>(1) Commercial<br>(2) DSN<br>*(If applicable)* | 7. DATE SUBMITTED:<br>*(YYMMDD)* |

## 8. PREPARING ACTIVITY

| a. NAME<br>COMMANDER<br>NAVAL FACILITIES ENGINEERING COMMAND<br>ATTN CODE 161B | b. TELEPHONE *(Include Area Code)*<br>(1) Commercial (2) DSN<br>(757) 322-4625 262-4625 |
|---|---|
| c. ADDRESS *(Include Zip Code)*<br>1510 GILBERT STREET<br>NORFOLK VA 23511-2699 | IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:<br>Defense Quality and Standardization Office<br>5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466<br>Telephone (703) 756-2340 DSN 289-2340 |